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CHEMICAL DIVISION.

DETERMINATION OF FATS IN FODDERS BY DIRECT WEIGHING OF THE ETHER-EXTRACT AND BY LOSS OF WEIGHT OF THE SUBSTANCE.

The present official method for the determination of fats in fodders requires that the substance should be dried in a current of dried hydrogen, at the temperature of boiling water, for four hours to remove all the moisture; the dried substance is then extracted with ether and the extract dried to constant weight under the same conditions.

In order to meet all these requirements Prof. Caldwell described in 1888 a "New Apparatus for Drying Substances in Hydrogen and for the Extraction of the Fat." A reference to the cut and the description¹ will show that these tubes serve the double purpose of glass stoppered weighing tubes, as well as drying tubes. This apparatus was made use of in the work described in this paper in the manner indicated in the bulletin, except that the current of hydrogen was conducted in the opposite direction. This change was found to be preferable, to prevent mechanical losses by particles of the substance being carried along with the current, and also to prevent the loosening of the asbestos filter from the metallic disk supporting it.

In the same bulletin Prof. Caldwell says:—"When the extraction is completed there seems to be no reason why the amount extracted cannot be determined by weighing the dried contents of the tube as well as by weighing the substance extracted: and the drying in hydrogen is much more easily managed in the former case than in the latter; but I have not yet had time to test this variation of the method."

¹ Bulletin No. 12 Cornell University Agr. Exp. Station.

At the seventh annual convention of the Association of Official Agricultural Chemists Mr. Anderson reported on two substances that the percentage of fat by loss of weight was a little larger than by weighing the extract. This he accounted for by saying that a portion of the fat was volatilized during the extraction.

In order to obtain some idea as to the favorable or unfavorable conditions for the loss of volatile fats during the extraction process, a short thermometer, $12\frac{1}{2}$ c. m. long, was imbedded in the fodder tubes when ready for the extraction. The thermometer was of such length that it would be entirely inclosed in the extraction apparatus. Another thermometer was inserted in the flask. A number of temperature determinations were made in this way. The temperature of the substance in the extraction tubes ranged from 33° to 35° centigrade, the temperature of the contents of the flask registered $41^{\circ}+43^{\circ}$ C.

The substance before and after extraction, and the fat, were all dried at the temperature of boiling water and it would hardly seem possible that the lower and intermediate temperature of 43° would be the cause of a loss of a portion of the extract by volatilization. During the extraction the fat is in solution, and the conditions are less favorable for volatilization than in either the previous or subsequent drying at the temperature of boiling water.

A number of comparisons were made by the two methods. The tubes were dried first for the official four hours to remove the moisture, but the data obtained in this way were discordant ; with some substances the agreement was close, but with others not so, there being a general tendency for higher results by the loss of weight. The work was repeated on the same substances in the following manner : instead of drying four hours, the drying was continued until duplicate weighings of the tubes agreed within one milligram. This required a variable length of time which always exceeded four hours, and in the case of gluten meal exceeded six hours. When the fats were determined by loss after drying in this way the agreement was much more satisfactory.

From the results thus obtained it appears that the first drying of four hours was not sufficient to remove all of the moisture, and the drying after the extraction removed the moisture left on the first drying ; so that the loss of weight of the tubes also included

a variable amount of moisture with the ether-soluble matter. Hence the larger results by loss of weight.

In the following table the results on the same line are from the same weighed portion. The tubes were dried in hydrogen both before and after the extraction, except that tube c in samples Nos. 6, 7, and 8, and tube b of No. 11 were dried in air after the extraction.

ETHER-EXTRACT.

	By loss of weight of extraction tube.	Average.	By weighing of ether-extract.	Average.
No. 1, Brewers' grains..	a 7.34		7.26	
	b 7.35	7.35	7.47	7.36
No. 2, Timothy hay.....	a 2.61		2.59	
	b 2.50	2.55	2.52	2.55
No. 3, Red clover hay	a 3.31		3.27	
	b 3.15	3.22	3.18	3.22
No. 4, Gluten meal.....	a 10.80		11.24	
	b 11.12		11.15	
	c 11.20	11.16	11.16	11.18
No. 5, Ensilage.....	a 2.22		2.19	
	b 2.28	2.25	2.32	2.25
No. 6, Cotton-seed meal.....	a 9.35		9.33	
	b 9.38		9.45	
	c 9.44	9.39	9.42	9.40
No. 7, Corn meal.....	a 4.04		3.92	
	b 3.92		4.04	
	c 3.85	3.93	3.85	3.93
No. 8, Ship stuff.....	a 4.31		4.37	
	b 4.72		4.67	
	c 4.56	4.53	4.46	4.50
No. 9, Ensilage.....	a 2.41		2.45	
	b 2.12	2.27	2.28	2.36
No. 10, Ensilage.....	a 3.20		3.20	
	b 2.73	2.97	2.73	2.97
No. 11, Ensilage.....	a 2.06		2.57	
	b 2.50	2.55	2.66	2.61
No. 12, Ensilage..	a lost		2.41	
	b 2.43		2.57	

The total average by weighing the fat was .006 per cent. higher than by the loss of weight, a difference which is insignificant.

The tubes are more convenient for drying than flasks, and no additional or expensive drying apparatus is required as for the

flasks. The drying of the tubes after the extraction can be done much more quickly and efficiently than drying the flasks, for the gas passes through the substance rather than over its surface, thereby requiring less hydrogen. More than this, the results show that the use of hydrogen in this second drying can be dispensed with.

On the whole, therefore, it is more economical as to time, apparatus and hydrogen, to determine the fats by loss of weight of the substance, while there is no loss in accuracy.

THE DETERMINATION OF ALBUMINOID NITROGEN.

In the determination of nitrogen by the Kjeldahl method directions are given for the addition of potassium sulphide to precipitate all mercury from the solution in order to prevent the formation of mercurio-ammonium compounds which are not completely decomposed by soda solution.

The determination of albuminoid nitrogen according to the present official method, requires the use of 0.7 to 0.8 grm. of copper hydroxide previous to the determination of the nitrogen by the Kjeldahl method.

The copper hydroxide is carried along in the determination, and is freely soluble in the sulphuric acid; no provision is made for its removal, and when the potassium sulphide is "added to precipitate all mercury in solution," copper sulphide is alike precipitable in the acid solution, with the mercury. The copper present is more than enough to combine with all the potassium sulphide; the result is that neither metal is completely precipitated, a large and variable portion of the mercury is left in the solution, and all the conditions are favorable for the formation of mercurio-ammonium compounds. The work given to the potassium sulphide is doubled and the object for which it is added is not attained.

In order to determine to what extent the mercury so left in the solution would affect the results, a number of determinations were started; to some the official "20 c.c. of potassium sulphide" were added, and to others a sufficient quantity of the same solution to precipitate all the copper as well as all mercury in solution. The

large amount of precipitate formed in the latter case caused so much bumping that only one determination out of six could be completed.

In order to obviate this difficulty the operation was carried on exactly as required by the official method, except that previous to distillation the acid solution was made up to 200 c.c. and divided into two equal portions. One portion was distilled with the relative official amount of potassium sulphide, and the second with enough of the same solution to make the precipitation of both mercury and copper complete. This gives a more satisfactory basis for the comparison of results, since all the conditions previous to the distillation are the same as to the degree of oxidation and the amounts of mercury and copper in solution.

The following results were obtained:

		50 c.c. K ₂ S.	30 c.c. K ₂ S.	Difference.
Ensilage No. 1.....		1.28 per cent.	1.12 per cent.	0.16 per cent.
" " 2.....		1.25 "	1.14 "	0.11 "
" " 2.....		.66 "	1.53 "	0.13 "
" " 3.....		.66 "	1.60 "	0.06 "
" " 3.....		1.36 "	1.27 "	0.09 "
" " 4.....		1.20 "	1.15 "	0.05 "
" " 4.....		1.52 "	1.45 "	0.07 "
" " 5.....		1.54 "	1.45 "	0.09 "
" " 5.....		1.18 "	1.08 "	0.10 "
		1.23 "	1.12 "	0.11 "
Average.....				.096

The constant larger proportion of nitrogen yielded in these results with the 50 c.c. of potassium sulphide must be due to the incomplete precipitation of all the mercury in solution when only 20 c.c. is added. The average difference in the ten portions amounts to nearly a tenth of one per cent.

Blank determinations with both 20 and 50 c.c. portions of potassium sulphide gave no nitrogen. A difference of a tenth of one per cent. when multiplied by the protein factor would make a difference of over six-tenths per cent. of protein, which is too great to be overlooked.

Some change must therefore be made in combining Stutzer's and Kjeldahl's methods. The following proportions of substance and solutions have given me satisfactory results. Take 0.7 gm. of substance instead of 1 gm., a quantity of copper hydroxide and glycerine solution equivalent to .5 to .6 grms. of the hydrox-

ide instead of .7 to .8, and finally 30 c.c. of potassium sulphide instead of 20 c.c. Trials of these proportions on the committee sample of corn meal gave 1.56 per cent. and 1.55 per cent. of albuminoid nitrogen ; with the old proportions, and all of the copper and mercury likewise precipitated, 1.56 per cent. of albuminoid nitrogen.¹

In the determination of *nitrates* by the official method, 2 grms of zinc dust are used ; but the previous addition of 2 grms. of salicylic acid converts the zinc into an insoluble form at the close of the digestion. This is shown to be true by the following results of the analysis of pure potassium nitrate, when the solution was divided as in the case of the determination of albuminoid nitrogen :

	20 c. c. K_2O .	40 c. c. K_2S .
1. Nitrogen.....	14.02 per cent.	14.02 per cent.
2. ".....	13.98 " "	13.98 " "

If in the above tests the salicylic acid is omitted the results obtained are not uniform, and fall short of the actual amount of nitrogen present. This is due to the presence of the zinc in solution, which causes the same trouble as the copper. Any other metal precipitable by potassium sulphide would be equally liable to produce the same effect, as all of the conditions would be equally favorable for the formation of mercurio-ammonium compounds.

DRYING SAMPLES OF FRESH MANURES.

In the analysis of farm manures, the most serious difficulty met with in the whole process, is the drying of the samples. If the sample is allowed to dry in the air, there is a possibility of a loss of nitrogen in the form of ammonia, and such drying is always accompanied by the formation of disagreeable volatile products. The sprinkling of the sample with a weak solution of oxalic acid has been proposed ; this answers very well, but it is open to the objections of retarding the drying at first by increasing the percentage of water.

The drying can be carried on by artificial heat without loss of ammonia in the following simple manner :

¹ These changes as given above have been adopted in the official method.

The sampling bottle in which the manure is received is provided with a two-hole rubber stopper. Through one of these holes a glass tube with six or eight holes blown out through its walls is carried to the bottom of the bottle ; another tube passes first through the other hole of the stopper and is carried from this bottle through an upright condenser, and then nearly to the surface of a small quantity of standard acid in an Erlenmeyer flask. Hot air is aspirated through the bottle containing the manure and thence through the condenser and Erlenmeyer flask, where all escaping ammonia is caught, and can be determined by titration.

This method has been applied to the drying of samples of horse and hog manure, with satisfactory results.

THE DETERMINATION OF NITROGEN IN SOILS.

For the determination of the total nitrogen in soils, the modified Kjeldahl method has been proposed so as to include the nitrous and nitric nitrogen ; but this modification introduces many difficulties. In dealing with soil a large quantity of substance must be taken for the determination, and the addition of zinc dust and salicylic acid farther increases this bulk ; the zinc dust cannot be intimately mixed with the soil without much labor; and the amount of nitrogen in the form of nitrates and nitrites is too small to be determined in this manner.

In the case of fifteen samples of soil analyzed in this laboratory, only one yielded as much as 0.001 per cent. of nitrous and nitric nitrogen ; this is too small a quantity to be determined by titration and it is moreover much within the limits of error in the determination of total nitrogen, as the following results on some of the same samples of soil show :

Soil sample.	Nitrogen per cent.	Soil sample.	Nitrogen per cent.
No. 1.....	.070	No. 4.....	.0795
"	.066	"	.076
No. 2.....	.057	No. 5.....	.052
"	.053	"	.055
No. 3.....	.068	No. 7.....	.051
"	.063	"	.053

Furthermore, the nitrogen in the reagents used in the modified Kjeldahl method is usually greater in amount than that from the nitrites and nitrates in soil. Reagents can be prepared for the usual Kjeldahl method that yield no nitrogen in blanks, while the same is not true of the modified method.

In the modified Kjeldahl method the breakage and proportion of loss from bumping is greater than in the direct method.

In view of the fact that the nitrates and nitrites are separately determined by more delicate methods, and that nothing is gained by the modified Kjeldahl method, while many difficulties are introduced by its use, the direct method is much to be preferred, with a separate determination of the nitrite and nitrate.

MISCELLANEOUS ANALYSES.

In the original substance.								
Name of sample.	Moist- ure.	Pure ash.	Ether- extr'ct.	Crude pro- tein.	Crude fibre.	N-free extr'ct.	Total nitro- gen.	Alb. nitro- gen.
Gluten meal.....	8.50	1.03	11.20	19.35	5.20	54.72		
Brewers' grain.....	10.65	4.27	10.65	20.00	11.52	46.21	3.20	
Cotton-seed meal.....	7.66	7.46	9.40		44.74	28.57	7.16	6.71
Corn meal.....	12.07	1.07	3.98	9.74	2.54	70.57	1.56	1.56
Ship stuff.....	11.84	5.20	4.51	17.74	8.25	52.46	2.84	2.09
Anthers of corn.....	9.15	5.70	2.49	17.19	17.45	48.02	2.75	
Pollen of corn.....	10.25		1.16	21.12	5.71	59.13		

SAMPLING MILK.

A large amount of literature has appeared from time to time upon the subject of sampling of milk, a review of which would lead one to believe that no two samples drawn from the same can, would, upon analysis, show the same composition, even with the special sampling tubes and other mechanical devices that have been proposed. During the months of July and August an opportunity was offered for a study of this question in connection with the experiment upon the effect of a grain ration for cows at pasture. Individual samples of milk were taken from the night and morning milkings of a herd of sixteen cows. Also the milk of the whole herd was divided into two lots, each lot representing

the milk of a whole day, of eight cows, and then sampled. The results of the analyses are given in the following table; the numbers 13, 7, etc., are those of the samples of milk from the corresponding cows. The sample designated as "mixture" is a sample of the mixed milk of the eight cows in each lot.

JULY 24, 1891.

<i>Lot I.</i>				<i>Lot II.</i>			
Sample No.	13	4.90	per cent. fat	Sample No.	8	4.80	per cent. fat
"	7	4.00	" " "	"	1	4.50	" " "
"	2	3.50	" " "	"	12	5.00	" " "
"	15	4.50	" " "	"	3	3.80	" " "
"	9	4.90	" " "	"	10	4.40	" " "
"	5	4.50	" " "	"	16	5.50	" " "
"	6	3.80	" " "	"	11	5.20	" " "
"	14	3.10	" " "	"	4	4.60	" " "
Average.....4.17 " " "				Average.....4.50 " " "			
Mixture.....4.10 " " "				Mixture.....4.50 " " "			

AUG. 22.

<i>Lot I.</i>				<i>Lot II.</i>			
Sample No.	13	4.95	per cent. fat	Sample No.	8	5.25	per cent. fat
"	7	3.75	" " "	"	1	3.40	" " "
"	2	3.70	" " "	"	12	5.00	" " "
"	15	4.80	" " "	"	3	3.10	" " "
"	9	5.60	" " "	"	10	4.60	" " "
"	5	4.65	" " "	"	16	5.00	" " "
"	6	4.85	" " "	"	11	6.20	" " "
"	14	4.80	" " "	"	4	4.75	" " "
Average.....4.31 " " "				Average.....4.63 " " "			
Mixture.....4.20 " " "				Mixture.....4.61 " " "			

From these results it would appear that the percentages of fat for each individual cow must represent, with a fair degree of accuracy, the real amount of fat present: for any slight error in the sampling of the mixed milk of each lot, or of the night or morning's milk of any of the individual cows would have made itself apparent in the results. These samples were taken by simply mixing the milk with a long handled dipper and the results show that for the quantity of milk sampled (180 lbs.), no sampling tube or other mechanical device was necessary. All the samples were brought to the laboratory in numbered bottles, and the analyst had no other information in regard to them till after all the analyses had been made.

HARRY SNYDER.

BOTANICAL DIVISION.

SOME NOTEWORTHY WEEDS.

Within a comparatively recent period a number of weeds have made their appearance in the state of New York, especially in the central counties, which show a marked tendency to become troublesome, while others of an earlier introduction appear to be increasingly aggressive. Three weeds belonging to the one or the other of these classes are here noticed.

1. GOLDEN HAWKWEED. (*Hieracium aurantiacum*). This plant is a foot or more in height and readily recognized by its very showy flowers (or rather flower heads) of a deep orange or flame color, appearing in early summer. It is a perennial, and increases by runners as well as by seeds. It is not mentioned in any of the earlier editions of Gray's Manual, but in the latest (1890) edition is spoken of as occurring in fields and by roadsides from New England to New York. It seems to have been for some time established near Oswego where it has taken possession of whole fields. Within the last few years it has been reported from a number of different places in the central part of the state. The plant shows all the qualities of a persistent and aggressive weed, except that it does not increase with very great rapidity. Its habit is such that it ought to be promptly exterminated whenever it makes its appearance. It is of European origin, and was probably first introduced into the new world as an ornamental plant; its habits, however, render it quite too dangerous to use for this purpose. Fig. 1.

2. FIELD CHAMOMILE. (*Anthemis arvensis*.) This plant is also a native of Europe, and although not of recent introduction, being spoken of by Darlington as quite common about New York City more than forty years ago, is nevertheless recorded as rare in the last edition of the Manual. It appears, however, to be rapidly increasing in central New York, showing a very decided



FIG. 1.—Golden Hawkweed (*Hieracium aurantiacum*). Drawn from nature by W. W. Rowlee.

tendency to become ~~abundant~~ and troublesome. It resembles the mayweed very closely in appearance, but the flowers are larger, the foliage of a deeper green color, and the odor more pleasant and agreeable. It is generally considered an annual, but the seeds of the current season become well established plants before the advent of winter. It appears like a species which through varietal change has produced new forms possessing greatly increased weed-like characteristics.

3. BEARD-TONGUE. (*Pentstemon lævigatus*, var. *Digitalis*.) This plant is a native from Pennsylvania west-ward, but has found its way into central New York where it promises to become a more or less troublesome weed. According to Mr. Rowlee it has taken possession of a field in the eastern part of Tompkins County, and seems to be increasing and spreading with a considerable degree of rapidity. The plant is four to five feet high, showy in appearance, with numerous white, tubular flowers, an inch or more in length, borne in loose clusters at the top of the stem. An effort should be made to prevent this plant from securing a foot-hold in other localities. It belongs to a family which furnishes a number of well known weeds among which the common mullein, the moth mullein, butter and eggs, and the speedwells, those pests of the lawn, may be mentioned. Fig. 2.

VARIATION IN ROOT PRESSURE IN DIFFERENT SPECIES.

By root pressure is meant the power of the roots of certain plants of forcing water, taken up by absorption from the soil, upwards into the stem. A familiar illustration of this power is seen in the grapevine when cut off in the spring, the roots forcing water upwards into the stem, causing it to run over, or bleed, at the cut surface. Root pressure, as here defined, appears to be wholly wanting in certain species, and in the same species occurs at different periods.



FIG. 2.—Beard-tongue (*Pentstemon laevigatus* var. *digitalis*). Drawn from nature by W. W. Rowlee.

The observations as here recorded are intended to show the variation in the force of root pressure in different species of green house plants grown in pots and subjected to the same conditions of heat, light and moisture. The plants were prepared for the experiment by cutting off the stems three inches above the ground and attaching a glass tube to the stump by means of a piece of rubber tubing, which was strongly wired at both ends as shown in the figure. The height to which the water rose in the glass tube was supposed to show the relative force of root pressure in the several species. The plants were all strong and healthy and apparently in a vigorous condition of growth.



FIG. 3.—Plant prepared to show root pressure.

In the following table the results of the experiment are shown, fractions being omitted.

TABLE I.

Kinds of plants.	Total rise of water in the tube in inches.	Average rise of water per 24 hours in inches.
Balsam a.....	97	11
“ b.....	49	5
“ c.....	61	5
Begonia a.....	65	3
“ b.....	57	2
Eucalyptus.....	1.5	
Coleus.....	15	1
Geranium.....	1.5	

The length of time in days during which the water continued to rise in the several tubes may be determined approximately by dividing the figures of the second column by those of the third.

In the following table the variation in root pressure is reduced to equivalent values, the lowest being taken as the unit. Fractions are omitted.

TABLE II.

Kind of plant.	Units of root pressure.
Balsam a	65
“ b.....	33
“ c.....	40
Begonia a.....	43
“ b.....	38
Eucalyptus.....	I
Coleus.....	10
Geranium.....	I

Summary.—The results show a marked variation in the force of root pressure in different species, and a considerable variation in different individuals of the same species.

A. N. PRENTISS.

AGRICULTURAL DIVISION.

DEHORNING.

We have received so many inquiries in regard to this practice that it has seemed worth while that we should give a brief outline of our experience, in this bulletin. We have made it a practice, for the past six or seven years, to dehorn our cows as soon as they come into the dairy, and at the present time there is no animal having horns on the farm. While for the most part, the horns have been removed by students and others who have never even seen the operation performed, we have, as yet, to meet the first case where there has been any ill effect following the operation. The last time the operation was performed, was on Nov. 5, 1891, at which time, among others, five cows in milk were dehorned. Three of these were heifers under two years old, two were mature cows that had been purchased in the neighborhood; all were comparatively fresh in milk. One, the first one in the table, had only been milked six days. In table I below, is shown the daily milk yield of the five dehorned cows on the day of the operation and for the five days preceding and following. In table II is shown the daily milk yield of seven cows, not dehorned, for the same days. These cows had been in milk approximately the same length of time as those dehorned.

TABLE I—DAILY MILK YIELD—FIVE DEHORND COWS.

	Days before dehorning.					Nov 5, 1891. Dehorn- ed. lbs.	Days after dehorning.				
	5th. lbs.	4th. lbs.	3rd. lbs.	2nd. lbs.	1st. lbs.		1st. lbs.	2nd. lbs.	3rd. lbs.	4th. lbs.	5th. lbs.
Carrie				7.25	8.50	8.75	8	9	8.25	8.75	8.50
Daisy	8.50	7.50	8.50	7.75	7.50	8.25	7.75	7.50	7.75	7.50	7.50
Ida	14.50	12.50	12	9.25	13	13	12.25	13	13	12.75	13.25
Pandora	27.25	26.50	24	26.75	27.50	24.50	18.50	25	75	25	23.75
Roxy	26.50	27.50	27.50	27.50	27	25.25	25.25	28	27.25	27.75	27.75

TABLE II—DAILY MILK YIELD—SEVEN COWS NOT DEHORNEO.

	5th. lbs.	4th. lbs.	3rd. lbs.	2nd. lbs.	1st. lbs.	Nov. 5, 1891.	1st. lbs.	2nd. lbs.	3rd. lbs.	4th. lbs.	5th. lbs.
Belva.....	40.75	38.25	42.50	37.50	40.75	34	36.50	41.50	39.25	38	37.50
Bertha.....	17.25	16	16.75	15.75	16	17	15.50	16	16	16.75	15.75
Freddie.....	42	42	45	41.50	44.50	43	43.25	43	43	40.50	40.25
Glista.....	20.75	20.25	21	23.25	22.25	21.50	23.75	22.25	22.50	22.25	20.75
Pearl.....	27.75	28	25.75	24	27.75	29.25	27	28	29.25	26.75	28.25
Ruby.....	19	19.75	20.25	21	22.75	24	22.50	24	22.50	23	22.75
Shadow.....	36.50	33.50	33	34.50	24.50	29	29	30.25	31	31.75	30

A glance at tables I and II shows that the cows dehorned were very little affected by the operation, with the exception of the cow, Pandora. It will be seen that she fell off three pounds upon the day on which she was dehorned and six pounds more on the following day, after which she nearly regained her normal flow. The variations in the case of the other cows were extremely trivial, and it will be seen by referring to table II that some of the cows not dehorned varied quite as much, and that, too, on the same days ; for instance, Belva fell off six and three-quarters pounds on the same day on which the others were dehorned, and Shadow fell off ten pounds on the day preceding. In the following table we have shown the losses immediately following the operation with each individual, and also the extreme variation in the whole period of five days before and five days following, and for purposes of comparison, have included the variations on these days for the cows that were not dehorned.

TABLE III.

	Av. daily yield for 5 days preced- ing. Lbs.	Gain + or loss — on day of opera- tion. Lbs.	Gain + or loss — on day follow- ing opera- tion. Lbs.	Total gain or loss in 2 days. Lbs.	Variation between lar- gest and smallest y'd in 11 days. Lbs.
<i>Cows dehorned :</i>					
Carrie.....	8 00	+ .75	— .75	+ .00	1.75
Daisy	8.00	+ .25	— .50	— .25	1.00
Ida	12.25	+ .75	— .75	+ .00	5.25
Pandora	26 50	— 2.00	— 6.00	— 8 00	9.00
Roxy	27.25	— 2.00	+ .00	— 2 00	2.75
Average.....	—	— .45	— 1.60	— 2.05	3 95
<i>Cows not dehorned :</i>					
Belva	40.00	— 6.00	+ 2.50	— 3.50	8 50
Bertha	16.25	+ .75	— 1.50	— .75	1.75
Freddie	43.00	+ .00	+ .25	+ .25	4.25
Glista	21 50	+ .00	+ 2.25	+ 2.25	3.50
Pearl	26 75	+ 2 50	— 2.25	+ .25	5.25
Ruby	20 50	+ 3.50	— 1 50	+ 2 00	5 00
Shadow	32.50	— 3.50	+ .00	— 3 50	12.00
Average	—	— .39	— .04	— .43	5 75

It will be seen that in the case of the dehorned cows, there was an average loss of a little more than two pounds per cow for the day of the operation and the day following, as compared with the average yield for the five days preceding. On the other hand, it will be seen that the seven cows that were not dehorned gave on these two days an average of forty-three hundredths of a pound of milk less than the average for the five days preceding ; so that not all of the two pounds could well be attributed to the operation of dehorning. When we come to consider the extreme variation in the yield, as shown in the last column of table III, it will be seen that the average variation of the five dehorned cows was a little less than four pounds in the whole period of eleven days, while the average variation of the seven cows, not dehorned, in the same period was nearly six pounds. This was undoubtedly due to the fact that the average milk yield of the seven cows not dehorned was considerably greater than of the five dehorned cows ; but it shows that the operation of dehorning did not cause at least any greater daily variation.

So much for the immediate effects of dehorning, now as to the time required for recuperation. We have shown in table IV the gain or loss in the milk yield for the five days following the operation as compared with the five days preceding, and here we find that there was an average daily loss of a little less than one-half a pound for the five cows dehorned, but in the same time the seven cows that were not dehorned, gave seven hundredths of a pound per day less in the last five days. It would seem then, studying the milk yield in all its relations, that the loss in milk yield, when cows in milk are dehorned, is insignificant.

TABLE IV.

Cows dehorned.	Average milk yield for 5 days before operation. Lbs.	Average milk yield for 5 days following operation. Lbs.	Gain + or loss — per day. Lbs.
Carrie	8.00	8.50	+ .50
Daisy.....	8.00	7.50	— .50
Ida.....	12.25	12.75	+ .50
Pandora..	26.50	23.75	—2.75
Roxy.....	27.25	27.25	+ .00
Average.....			— .45
Cows not dehorned.			
Belva.....	40.00	38.50	—1.50
Bertha.....	16.25	16.00	— .25
Freddie.....	43.00	42.00	—1.00
Glista.....	21.50	22.25	+ .75
Pearl.....	26.75	27.75	+1.00
Ruby.....	20.50	23.00	+2.50
Shadow.....	32.50	30.50	—2.00
Average.....			— .07

The only requisites for successfully performing the operation are that the animal's head should be securely fastened and the operator possessed of courage, and a sharp saw. We have ordinarily used what is known by carpenters as a "cut off" saw; that is, a small, flexible saw, with rather fine teeth; others have preferred to use a stiff back saw. The horns should be removed from the head so as to take with them just a few hairs, all the way around. It is usually of advantage to clip off some of the hairs about the base of the horn, with a pair of shears, and before beginning, the operator should examine the horn and get his bearings, so that when once the operation is begun no stop need be made until the horn comes off; ordinarily but very little blood is lost in the operation; some animals, however, will bleed considerably and very rarely it is necessary to bind a rag smeared with

pine tar over the stump to stop the bleeding. Animals under three years old that are in good flesh and thrifty growing condition are more apt to bleed freely. It is not necessary that any application be made to the stump, but we have thought it of advantage to apply a little carbolated vaseline; this is chiefly of benefit in warm weather in keeping away flies. Usually the wound heals up without suppurating but in about one case in ten, some pus will form. We have found it of advantage in such cases to bind on a rag smeared with pine tar as before described.

Since the operation referred to above was performed Mr. S. Alfred Seely, of Spencer, N. Y., sent us for trial a pair of patent dehorning clippers, invented by Dr. H. W. Leavitt, of Hammond, Piatt Co., Ill. We have used these upon the cattle of our neighbors sufficiently to show us that they are far superior to any method we have yet seen devised. They act upon the principle of the pruning shears and remove the horns more easily than the saw and with apparently considerably less pain to the animal.

A NEW MATERIAL FOR PRESERVING EGGS.

In the summer of 1890 we received from Messrs. A. E. Richter & Co., of Fond du Lac, Wis., through Messrs. Munn & Co., of New York, a package of material with a request that it should be tested as a material in which to pack eggs for preservation till winter.

The material was a brick red mineral, extremely finely ground, and a chemical analysis showed that it was principally composed of silicates of iron, lime and aluminum, the reddish color being due to the iron.

Sept. 9th, there was purchased from a dealer in the city, some eggs, guaranteed by the expert in the employ of the firm to be fresh. Part of these eggs were packed in a barrel with the Richter mineral, part in a nail keg in fine salt, and still another part in a stone crock in a solution of lime water and brine. All were placed in a dry, cool room where the temperature varied from fifty-five to sixty-five degrees.

Jan. 21, 1891, the eggs were unpacked; there were taken out the following numbers:

From the Richter mineral.....15 dozen and 11.

From the salt 9 dozen and 9.

From the solution of lime water and brine, 3 dozen and 6.

They were examined carefully with a candle by the same expert from whom the eggs were purchased and the following numbers were thrown out as absolutely bad from each lot :

From the Richter mineral..... 9 eggs or 4.7 per cent.

“ “ salt.....5 “ “ 4.3 “

“ “ solution of lime water and brine 2 “ “ 4.8 “

It will be seen that no better results were obtained from the use of this mineral than from the use of salt. or lime water and brine. To further test the matter, some eggs known to be not more than two days old were purchased, and with the eggs preserved in the different ways, and all marked simply with numbers, were sent to eight different ladies in the neighborhood, with the request that a cooking test be made of each of the lots, and their opinion given as to their comparative value. All, without exception, pronounced the preserved eggs much inferior to the fresh, and most of the ladies reported that, of the preserved eggs, those kept in salt were somewhat better than those preserved in the Richter mineral.

It would seem that this new material for preserving eggs, offers no advantage over the use of fine salt.

I. P. ROBERTS.

ENTOMOLOGICAL DIVISION.

THE HORN FLY.

Hamatobia serrata.

Order DIPTERA ; family MUSCIDAE.

A small black fly, one half the size of the common house fly, attacking cattle in the field, and oftentimes resting in large numbers around the base of the horns.

This recently imported European cattle pest first made its appearance in considerable numbers in this country near Philadelphia during the summer of 1887. Since that time it has spread quite rapidly in all directions and now the farmers of at least nine states (Pennsylvania, Delaware, New Jersey, Maryland, Virginia, West Virginia, New York, Kentucky and Ohio) recognize it as a troublesome pest among their cattle. During the past summer the flies have appeared in the southern, the central, and the extreme western portions of our State ; and inquiries regarding the new pest have been so numerous that it seems advisable to here briefly discuss what is known of its habits, its life history, and the remedies which have been recommended.

The insect has been investigated by Dr. Riley and Mr. Howard of the Department of Agriculture at Washington, and by Prof. J. B. Smith of the New Jersey Experiment Station ; our information is condensed from their published reports.*

The insect appears to be a native of southern Europe, where it has not however been reported as a serious pest. It was probably brought to this country with imported European cattle about 1886. The fly, which has been known in Europe since 1830, is of a dark greyish-black color and belongs to the same order of insects as our common house fly, which it resembles in general

* Riley and Howard : Annual Rept. of U. S. Entomologist, 1889, p. 345-348 ; l.c. 1890. p. 246-249 ; Insect Life, Vol. 2, p. 93-104 ; l.c. Vol. 3, p. 42.

Smith : Bulletin No. 62, New Jersey Experiment Station, Nov. 1889, 40 pages.

appearance. It is about one sixth of an inch in length and its whole body is quite densely clothed with stiff blackish hairs. The head is almost entirely taken up by the eyes, which are of a dark reddish-brown color. The proboscis, the instrument with which the biting is done, is conspicuous and when the fly is at rest it projects straight forward from the head ; on each side of the proboscis is an unusually long palpus densely clothed with short stiff hairs. The abdomen is rather small, almost as broad as long and flattened above.

In localities where the pest has become established, the flies first appear in May. They increase in numbers very fast until in June and July they appear in swarms and torment the cattle to such an extent that in many cases the animals lose condition and the yield of milk is lessened from one-third to one half. As fall approaches the flies become less and less numerous and finally disappear with the first cold and frosty weather.

The flies instinctively seek those portions of the body which are not easily reached by the head or the tail of the animal, as the back, the flanks, beneath the belly, and on the udder. A fly alights on the animal, quickly works its way, with wings still expanded and ready for instant flight, among the hairs, and soon the proboscis has punctured the skin and the blood of the animal is being pumped into the body of the fly. During the early part of the summer especially, the flies congregate in large numbers about the base of the horns. This peculiar habit suggested the popular name, the Horn Fly. The flies do not feed upon the horn or the skin about its base as many suppose, but they simply rest there with the wings folded over the back. In some cases large sores are found on the body of an animal in its efforts to rid itself of the flies by continued rubbing against objects and by licking the spot where bitten. The flies usually confine their attacks to the cattle in the field but sometimes they follow the animals indoors and torment them in the stables.

The early stages of the Horn Fly are not passed on the cattle as some suppose, but in and beneath the piles of freshly dropped dung in the field. The eggs, which are only .05 of an inch in length and .015 of an inch in diameter are of a reddish brown color and are laid during the daytime on the surface of dung which has just been dropped. In shape the

eggs are elongate oval slightly curved with one side flattened. Within twenty-four hours a narrow spoon-shaped strip splits off from the flattened side of the egg, and a white footless grub emerges and descends for a short distance into the dung upon which it feeds. The grub or larva grows rapidly and in about five days it is full grown and measures .35 of an inch in length. It is of a dirty white color, nearly smooth, and tapers considerably toward the head which is cleft at the tip. When full grown the larva descends for a short distance into the ground below the dung. It there shrinks nearly one half in length, the skin hardens, becomes reddish-brown in color, and a short elliptical puparium results. While in this state which lasts about six days, the insect remains inactive. A fully developed fly emerges from the puparium and soon joins its comrades on the bodies of the cattle. Thus the whole life cycle of the pest from the laying of the egg to the appearance of the fly occupies a period of only about two weeks. This rapid multiplication of the species accounts for its appearance in such swarms and renders it possible for seven or eight generations of the flies to appear during the year. The winter is probably passed in the pupa state in the ground beneath the dung.

Remedies.:—Two classes of remedies are practicable ; preventive, to prevent injury to the cattle by keeping off the fly ; and destructive, by destroying the insect in its larval or adult condition. The fly may be kept away from the cattle for several days by the application of almost any greasy substance to the parts more liable to attack. Fish oil, to which a little carbolic acid has been added as a healing agent, is the most highly recommended ; common axle-grease, tallow, kerosene emulsion, or sheep-dip may be used to good advantage. The substance may be applied with a sponge or as a spray. One thorough application is often sufficient, but as its repelling power usually lasts only five or six days, it may be necessary to repeat the application.

Among the destructive agents for the fly, tobacco powder is considered the best. It should be dusted on those parts where the flies most usually congregate, and it is certain death to those that come in contact with it. The larvae may be destroyed by scattering a little lime or plaster on the fresher droppings in

the field. This should be done in the early part of the season as every larva killed then represents the death of many flies later. In many cases this is a very practical remedy for the lime or plaster is cheap and in almost every field there are some spots where the cattle preferably congregate during the heat of the day and the droppings will be more or less together and easy to treat.

MARK VERNON SLINGERLAND.

HORTICULTURAL DIVISION.

PHYSALIS,* OR HUSK TOMATO.

Under the name of Husk Tomato, Strawberry Tomato, Winter Cherry, and Ground Cherry, species of *physalis* have come into prominent notice during the last few years. The genus *physalis* is somewhat allied to the tomatoes and red peppers, and like most other groups of the family it is puzzling to botanists. There are a number of native species of *physalis*, one or two of which are well known in some parts of the country as ground cherry, and the fruits of which are esteemed for preserves. In fact, one of these native plants (*Physalis pubescens*) is the same species as the commonest husk tomato of the gardens, although the cultivated form probably came first from some tropical or sub-tropical country. This species is very widely distributed. There has been no recent attempt to distinguish the species and varieties of our cultivated *physalis*, and knowledge of them is greatly confused. We have grown seven species,† only three of which need be discussed here, as they are the only ones which appear to have been introduced into cultivation as fruit-bearing plants. These three are as follows :

1. *PHYSALIS PUBESCENS*. Fig. 4. This is the common Strawberry Tomato of seedsmen (the Erdbeer tomato of the Germans), the Dwarf Cape Gooseberry, Golden Husk Tomato, and the Improved Ground Cherry (of Childs). It is a low plant, trailing flatly upon the ground, or sometimes ascending to the height of a foot. The leaves are rather thin and nearly smooth, more or less regularly and prominently notched with blunt teeth. Flowers small ($\frac{3}{8}$ in. or less long), bell-shaped, the limb or border erect and whitish-yellow, the throat marked with five large brown

*Pronounced *Fiss'-a-lis*.

†*Physalis pubescens*, Linn. *P. Peruviana*, Linn. *P. capsicifolia*, Dunal. *P. Alkekengi*, Linn. *P. viscosa*, Linn., from Paraguay (collected by Dr. Thomas Morong). *P. angulata*, Linn., and *P. obscura*, Michx., from our southern states.

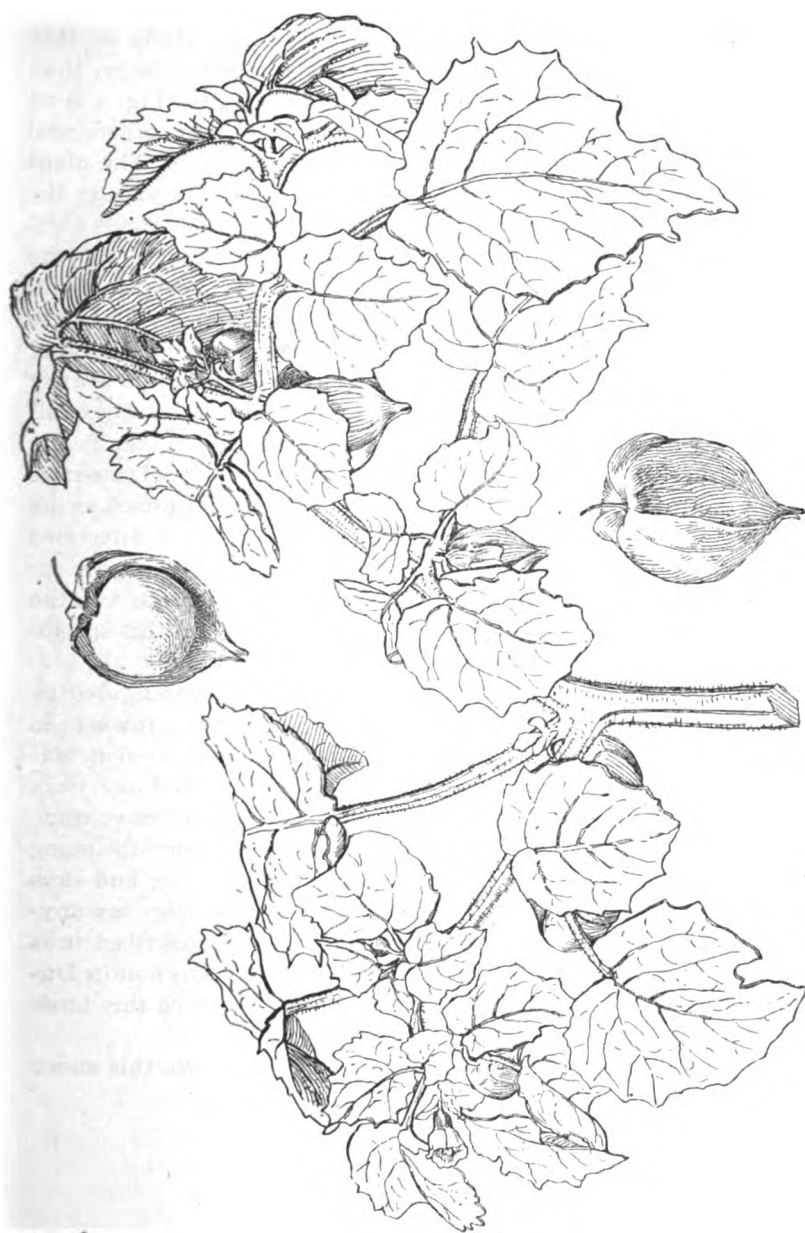


FIG. 4.—Common Strawberry Tomato (*Physalis pubescens*, Linn.). Detached fruits full size.

spots; anthers yellow. The husk is smooth or nearly so, thin and paper-like, prominently 5-angled and somewhat larger than the small, yellow, sweetish and not glutinous fruit. Fig. 4 is an excellent portrait of this species. The detached fruits are natural size, although the fruit is sometimes larger than these. The plant is very prolific, and the fruits are considerably earlier than in the other species. When ripe, the fruits fall, and if the season is ordinarily dry they will often keep in good condition upon the ground for three or four weeks. The fruits will keep nearly all winter if put away in the husks in a dry chamber. They are sweet and pleasant, with a little acid, and they are considerably used for preserves, and sometimes for sauce. The plant is worthy a place in every home garden. It is grown more or less by small gardeners near the large cities, and the fruits are often seen in the winter markets. The chief objection to the plant is its prostrate habit of growth, which demands a large amount of ground for its cultivation. In good soil it will spread four feet in all directions if not headed in, but as we ordinarily grow it, the plants are set in rows three or four feet apart and two or three feet apart in the row. We have made repeated attempts to hybridize this species with others, and *vice versa*, but always without success.

This *Physalis* has been long in cultivation. It was figured by Dillenius in 1774, in his account of the plants growing in Dr. Sherard's garden at Eltham, England*. In 1781-6 it was figured by Jacquin†, and by him called *Physalis Barbadosensis*, from the island of Barbadoes, whence it was supposed to have come into cultivation. In 1807, Martyn‡ described it under the name of Barbadoes Winter Cherry or *Physalis Barbadosensis*, and says that it is a native of Barbadoes. None of these authors say anything about its culinary uses. Dunal||, in 1852, described it as var. *Barbadosensis* of *Physalis hirsuta*, but later botanists§ unite Dunal's *P. hirsuta* with Linnæus' *P. pubescens*, of which this husk tomato is but a cultivated form.

2. *PHYSALIS PERUVIANA*. Fig. 5. I have grown this under

* Hort. Eltham. t. 9, fig. 9.

† Icones Pl. Rar. i. 5, t. 39.

‡ Martyn's Miller's Dict. 1807, *Physalis* No. 14.

|| D. C. Prodr. xiii (i). 446.

§ See A. Gray, Syn. Fl. ii. part 1. 234.

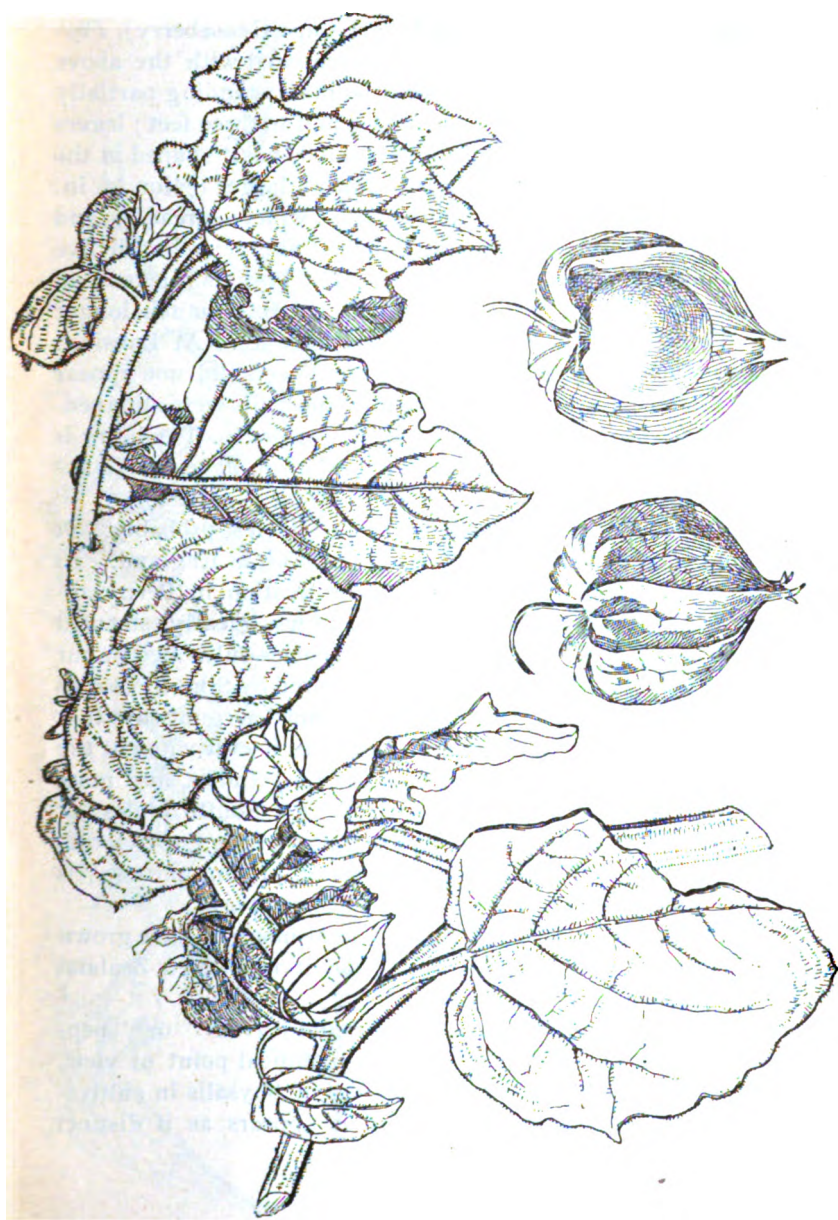


FIG. 5.—Peruvian Husk Tomato (*Physalis Peruviana*, Linn.). Fruits natural size.

the names Cape Gooseberry (not Dwarf Cape Gooseberry), *Physalis Peruviana*, and *P. pubescens*. As compared with the above species, it is a much stronger grower, the plant standing partially erect and attaining a height of one and a half to three feet; leaves thicker, less regularly toothed, more pointed, heart-shaped at the base, and very pubescent or fuzzy; flowers larger ($\frac{1}{2}$ or $\frac{3}{8}$ in. long), open-bell-shaped, the limb or border widely spreading and light yellow, the interior or throat blotched and veined with five purple spots, the anthers blue-purple. The husk is thicker and larger than in the last, somewhat hairy, and has a much longer point. This species is too late for our climate. At Lansing, Michigan, during two or three years, the flowers did not appear until the middle of August, and very few ripe fruits were obtained. Here at Ithaca perhaps a fourth of the crop ripens. The berry is yellow, not glutinous, and much like that of *P. pubescens* in appearance, but it seems to be less sweet than that species.

This plant has been cultivated for two centuries, probably. It was described and figured by Morison in 1715* in England. In 1725 Feuillée† gave a description of its cultivation in Peru, saying that it was then cultivated with care and was greatly esteemed as a preserve. The particular form of the species cultivated in our gardens is that which was described and figured by Sims in 1807 as *Physalis edulis*, the "edible physalis."‡ Sims' account says that "this plant is a native of Peru and Chili, but is cultivated at the Cape of Good Hope, in some parts of the East Indies, and more especially at the English settlement of New South Wales, at which latter place it is known by the name of the Cape Gooseberry, and is the chief fruit the colonists at present possess; is eaten raw, or made into pies, puddings, or preserves."

This plant is rarely sold by American seedsmen. I have grown it mostly from French seeds. I once had it from New Zealand under the name of Cape Gooseberry.

3. *PHYSALIS CAPSICIFOLIA*, "capsicum leaved" or "pepper-leaved physalis." Fig. 6. From a botanical point of view, this is one of the most interesting species of physalis in cultivation. It is exceedingly variable, and it appears as if distinct

* Pl. Oxon. 3, 526, sect. 13, t. 3, fig. 17.

† Journ. Obs. Phys. Math. et Bot. iii. 5, t. 1.

‡ Bot. Mag. t. 1068.



FIG. 6.—Pepper-leaved *Physalis* (*Physalis capsicifolia*, Dunal). Fruits full size.

varieties can be readily bred from it. We have grown it under two or three names. It is usually called, though erroneously, *Physalis edulis*. This name is misleading, for the fruit is really scarcely edible because of its very pronounced mawkish flavor. The fruit is far the largest and handsomest of any *physalis* which I have grown, and it is not improbable that we may be able to obtain a desirable variety from it. The plant is exceedingly productive, and adapts itself to almost any soil or condition. It grows erect to a height of three or four feet, bearing smooth branches and leaves. The leaves are thin, ovate or lance-ovate and variously toothed or notched. The flowers are large and open ($\frac{3}{4}$ in. or more across), the border bright yellow and the throat bearing five black-brown spots; anthers purplish. The husk is entirely filled by the large round sticky berry, and is sometimes torn open by it.

This plant is supposed to be native to South America or the West Indies. It was early grown in gardens, perhaps because of its supposed medicinal properties. Dr. Sherard obtained it in Holland in the last century and grew it in his garden at Eltham, England, and Dillenius figured it in 1774.* Martyn† described it in 1807, but says nothing about its uses. An interesting feature of the plant is its great variability. Dillenius figured the leaves as nearly entire, and Dunal,‡ who named the plant, so describes them; but the greater part of the cultivated specimens have conspicuously toothed leaves.

We have tried a number of interesting experiments with this species. A year ago one plant appeared in our plantation which bore profusely of unusually large and purple fruits, and which was very dwarf and stocky in habit. The plant was so attractive that we saved seeds of it. All the plants this year were entirely unlike the parent, being very tall growers and bearing an ordinary crop of medium green-husked fruits. But the most singular circumstance was the fact that while the plants were all unlike the parent, they were nevertheless very like each other! In other words, there was almost no variation in the offspring. Now, alongside these plants were sown unselected seeds, and from them we secured scarcely two plants alike. The first plant in the

* Hort. Eltham. t. 11.

† Martyn's Miller's Dict. *Physalis* no. 11.

‡ D. C. Prodr. xiii (i). 449.

row, for instance, was low and straggling (only 16 in. high), the branches lying almost horizontal ; the leaves were small and the branches green. The second plant in the row was erect (growing 3 ft. high), with large leaves and purple branches. The first nine plants represented nine very different types, the differences being, in some cases, even greater than those which ordinarily distinguish well marked varieties of cultivated plants. Numerous attempts have been made to cross-pollinate this species, but without success.

In conclusion, we may say that three species of *Physalis* or husk tomato are cultivated for fruit. One of these, variously known as the Strawberry Tomato, Golden Husk Tomato, Dwarf Cape Gooseberry and Improved Ground Cherry, is well worth growing in the home garden. The true Cape Gooseberry is too late for this latitude. The pepper-leaved *Physalis*, erroneously known as *Physalis edulis*, is unfit for general cultivation for fruit, although it is an interesting plant to the experimenter.

PEPINO.—*Solanum muricatum*.

Within the last few years a novelty has appeared in the seedsmen's catalogue under the name of Pepino, Melon Pear, Melon Shrub, and *Solanum Guatemalense*. Its botanical affinities, as well as its horticultural merits, have been a perplexity. We have now grown the plant for two seasons, in the house and out of doors, and it has proved so interesting and unique that I have prepared this account of it.

The plant is a strong growing herb or half shrub in this climate, becoming two or three feet high and as many broad. It has a clean and attractive foliage, comprised of long-lanceolate nearly smooth very dark green entire leaves. It is a profuse bloomer, the bright blue flowers reminding one of potato flowers. But one fruit sets in each flower cluster, and as this grows the stem elongates until it reaches a length of from four to six inches. The fruit itself is very handsome. As it ripens it assumes a warm yellow color which is overlaid with streaks and veins of violet-purple. These fruits are somewhat egg-shaped, conspicuously pointed, and vary from two and a half to three and a half inches in length. The illustration, Fig. 7, shows the natural size of an average specimen. If the fruits are still green upon the approach

of frost, they may be placed in a cool dry room where, in the course of two or three weeks, they will take on their handsome color. If carefully handled or wrapped in paper, the fruits will keep until mid-winter or later. The fruit is pleasantly scented, and the flavor of it may be compared to that of a juicy, tender and somewhat acid egg-plant. It is eaten either raw or cooked.

Upon the approach of winter we dig up some of the plants and remove them to the conservatory or forcing-house. It is in the capacity of ornamental plants that they will probably find their greatest usefulness in this latitude. The habit is attractive, the flowers bright and pleasant, and the fruit—if it is obtained—is highly ornamental and curious. The plant will stand a little frost.

The plant has not fruited freely with us, however, although it blooms profusely. We have endeavored to insure fruiting by hand pollination, but without success. The anthers give very little pollen. Perhaps half the plants succeed in setting two or three fruits apiece. All the fruits which we have raised have been entirely seedless, and this appears to be the common experience. The seed-cavities remain, however, as shown in the cross-section in Fig. 7. The plant must be propagated by cuttings or layers, therefore. We obtained our stock from a botanical specimen which I obtained from Florida, and which was not thoroughly dried.

This plant was introduced into the United States from Guatemala in 1882 by Gustav Eisen, of California.* There has been much speculation as to its nativity and its true botanical position. At first it was thought by some to be a variety of the egg-plant,† but it is very distinct from that species. But the plant is by no means a novelty to science nor even to cultivation, for it was accurately described and figured so early as 1714 by Feuillée in his account of travels in Peru‡. He called it *Melongena laurifolia*. At that time the plant bore "several little lenticular seeds, one line broad." It was carefully cultivated in gardens, and the Indians ate it with delight. The taste is described as somewhat like a melon. Eating too heartily of it was supposed to bring on

* Orch. and Gard. x. 61 (1888).

† Gard. Monthly, xxix. 24, 48, 84, 120, 355 (1887).

‡ Journ. Obs. Phys. Math. et Bot. 735, t. 26.

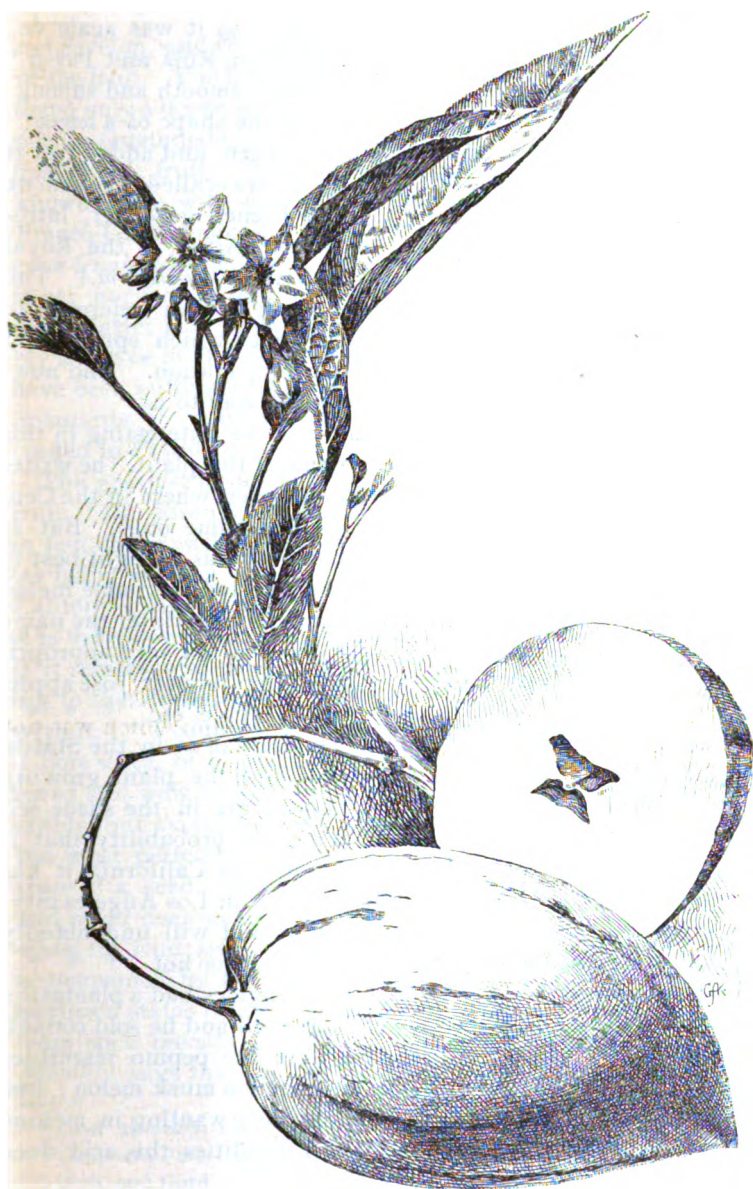


FIG. 7.—Pepino (*Solanum muricatum*, Aiton).

fevers. In Lima it is called Pepo. In 1799 it was again described and figured by botanists visiting Peru, Ruiz and Pavon.* They described the fruit as "ovate, pointed, smooth and shining, white variegated with purple, hanging, of the shape of a lemon." They say that it was much cultivated in Peru, and added that it was propagated by means of cuttings. It was called "Pepino de la tierra." In 1785, Thouin, a noted French gardener, introduced it into Europe, and four years later Aiton, of the Royal Garden at Kew, England, named it *Solanum muricatum*.† The specific name, *muricate* or *prickly*, was given in reference to the rough or warty character of the sprouts which spring from the root and which are often used for propagation. And now, over a hundred years later, it has found its way to us.

Mr. Eisen's account of the pepino will be interesting in this connection. "The Central American name of this plant," he writes "is pepino. Under this name it is known everywhere in the Central American highlands, and under this name only. But as pepino in Spanish also means cucumber, it was thought best to give the plant an English name. I suggested the name melon shrub, but through the error or the wisdom of a printer the name was changed to melon pear, which I confess is not very appropriate, but still no less so than pear guava, alligator pear, rose apple, strawberry guava, mango apple, custard apple, etc. * * *

As to the value of the fruit and the success of it in the States, only time will tell. The fact that I found the plant growing only on the high land where the temperature in the shade seldom reaches 75° Fahr., suggested to me the probability that it would fruit in a more northern latitude. In California it has proved a success in the cooler parts, such as in Los Angeles city, and in several places in the coast range, and will undoubtedly fruit in many other localities, where it is not too hot. * * *

My friend, the late Mr. J. Grelck, of Los Angeles, had a plantation of 10,000 pepinos, which grew and bore well and he sold considerable fruit. * * *

In pulp and skin the pepino resembles somewhat the Bartlett pear, but in taste more a musk melon; but it has besides a most delicious acid, entirely wanting in melons and quite peculiarly its own. In warm localities this acid does

* Flora Peruviana, ii. 32, t. 162 a.

† Hort. Kew. i. 250.

not develop, and this fact is the greatest drawback to the success of the fruit. The fruit has no seed, as a rule. And in all, I have found only a dozen seeds, and those in fruit which came from Salama in Guatemala, a place rather too warm to produce the finest quality of fruit. The botanical name of the pepino is not known to me with certainty. The same was described by the Franco-Guatemalan botanist, Mr. Rousignon, as *Solanum Melongena Guatemalense*, but it is to me quite evident that this solanum is not, nor is it closely related to the *S. Melongena* or egg-plant, which latter is a native of Central Asia. The pepino is probably a native of the Central American highlands, and appears to have been cultivated by the Indians before the conquest by the Spaniards."* Last year Mr. Eisen writes that "it has only succeeded in Florida, but has there proved of considerable value."†

The greatest fault of the pepino appears to be its failure to set fruit. Mr. Eisen states that in Guatemala it "yields abundantly, in fact enormously, 100 to 150 fruits to a vine four feet in diameter being nothing uncommon. I have seen it yield similarly in California, but whenever exposed to too much heat and dryness, it is very slow to set fruit."‡ He recommends that it be shaded if it refuses to set fruit. Martin Benson, Dade Co., Florida, writing to the *American Garden*,|| says that he has had great success with it. "I counted the fruit on a medium sized plant and found it bore sixty, of all sizes, from those just set to some nearly matured and weighing upwards of a pound. The fruit varies considerably, but averages about the size of a goose egg. The fruit is the most perfectly seedless of any I have ever seen, without a trace of a seed. It requires cool weather in order to set fruit, and never does so excepting during a norther or other cool spell, when the fruit sets in great quantities." Mr. Benson's letter is accompanied by an admirable illustration of the fruit. In the northern states it has always proved a shy bearer, if I may judge from such records as exist. "D," writing to the *Gardener's Monthly*, says that he had "only about two pears to each plant,

*Gard. Monthly, xxix. 84 (1887)

†Gard. and Forest, iii. 71 (1890).

‡Orch. and Gard. x. 61 (1888).

|| ix. 265 (1888).

among literally hundreds of blossoms.”* *Orchard and Garden*† comments upon this feature as follows: “The general experience with it here [New Jersey], thus far, seems to justify us in calling it exceedingly shy in setting fruit, and if this tendency to abortive blooming cannot be overcome, the melon pear must be considered without practical value.” These remarks are certainly counter to the statements and pictures made by some seedsmen in regard to its productiveness.

The pepino is an unusually interesting plant, and if it could be made to set fruit more freely in the north, it would be an acquisition for the kitchen garden and for market. It is a good ornamental plant. Altogether, it is deserving of a wider reputation.

CHOROGI.‡—*Stachys Sieboldi*.

Stachys Sieboldi, Miquel, Ann. Mus. Bot. Lugd-Bat. ii. 112 (1865-6).

Stachys affinis, Bunge, Mem. Savans. St. Petersb. ii. 51 (1834), not Fresenius.

Stachys tuberifera, Naudin, Bull. Soc. d'Acclim. France, 1887, 394.

In 1882 Dr. Bretschneider, physician to the Russian legation at Peking, sent to the Society of Acclimatization of France tubers of a mint-like plant which is cultivated in China. The Society transferred the tubers to Mr. Paillieux, at Crosnes, near Paris, who grew them that season, and who has since been largely instrumental in introducing the plant to the horticultural world. Three or four years after its introduction the plant began to attract attention in France and England, and in 1887 Naudin named it *Stachys tuberifera*, upon the supposition that it is really not the true *Stachys affinis*, under which name it had passed. It appears to have been grown in England about as early as in France, probably from some of the stock which Paillieux had received or which he grew the first year.|| It was first exhibited in England Dec. 13, 1887, before the Royal Horticultural Society by Mr.

* Gard. Monthly, xxix. 355 (1887).

† x. 12 (1888). This article is accompanied by an illustration of the fruit, the first to appear, apparently, in this country.

‡ Pronounced Chor'ogi: ch soft, as in *chore*; both o's long; g hard; i short, as in *il*.

|| Gard. Chron. 3 ser. iv. 608; iii. 211. Garden, xxxiv. 464.

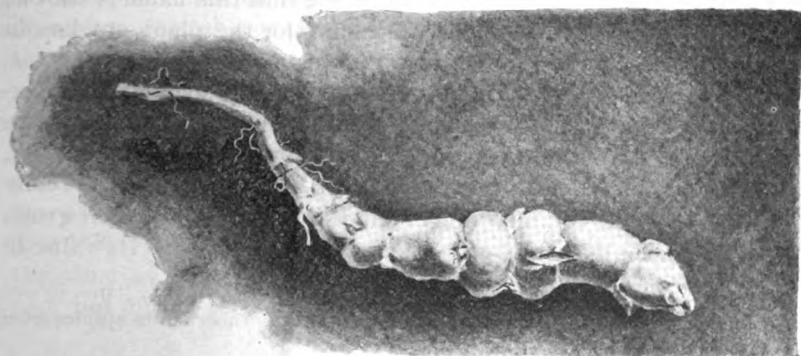


FIG. 8.—*Chorogi* (*Stachys Sieboldi*, Miquel). Detached tuber natural size.

Haskings, gardener to Sir Henry Thompson of West Mousley. It was certificated by the Society Nov. 14, 1888. It had now been introduced to the horticultural trade, chiefly by Vilmorin, of Paris, under the name of *Crosnes du Japon*, in allusion to the home of Mr. Paillieux where it had been most extensively grown, and in reference to the country whence it was supposed to have come originally. In the spring of 1888 it was introduced into this country under two names, *Stachys affinis* and *S. tuberifera*. In 1890, Hemsley, writing of the botany of China,* determined that the proper name of the plant is *Stachys Sieboldi* of Miquel.

It still remains to determine upon a good English name for the plant. Many names have been proposed, as Chinese artichoke, Japanese artichoke, knotroot, curlroot, and spirals, all of which are more or less objectionable if the plant is ever to assume any importance in trade. Some contend that the French *Crosnes du Japon* should be used, but this name does not suit an English vernacular. It is also proposed to call it by the scientific name, but a Latin name would hinder the popularizing of the plant. Again, the simple generic name *stachys* has been proposed, but as other species of *stachys* may come into cultivation in the kitchen garden, the name might lead to confusion. † It has seemed to me better to adopt some aboriginal name of the plant if a simple one can be found, and I have therefore ventured to use the Japanese name *chorogi*. This name has been suggested in English journals, but does not appear to have been adopted by any writer. Professor Georgeson, who is well known as a student of Japanese plants, and Mr. Takahashi, a Japanese student in the Cornell College of Agriculture, both inform me that this name is the one in use in Japan. The Chinese names for the plant are *kan-lu* and *tsan-yungtzu*.

Chorogi is a small perennial plant, with the aspect of peppermint or spearmint. It belongs to the mint family, and to a genus (*Stachys*) which is well represented in this country. In fact, there is some doubt among botanists as to whether it is really distinct from a common wild *stachys* (*S. palustris*) which grows in wet places over a large part of North America. Its value to

* Journ. Linn. Soc. xxvi. 301.

† We are now experimenting with an interesting tuberiferous species from Florida.

the gardener lies in the great number of crisp white tubers which it produces just under the ground. These tubers are thickened underground stems, like the potato tuber. Fig. 8 is an illustration of a plant as it appears in November, after being dug and having the earth washed from the roots. The detached tuber is natural size, and represents an average specimen as grown upon naturally poor but well enriched sandy soil. Although the tubers are small, they are so abundantly produced as to make the plant a heavy yielder. We imported tubers in the winter of 1889-90. They were in poor condition when planted, and the growth during 1890 was small. The plants were allowed to remain without protection during the winter, and this year they have spread so as to fill a row a foot and a half wide and have produced great numbers of tubers. We have eaten the tubers in several ways and I do not hesitate to pronounce the plant the most important acquisition to our list of secondary vegetables which has been made in several years. The tubers can be cooked in a great variety of ways, or they may be eaten raw. They are fried, roasted, baked, pickled, preserved, stewed in cream, and made into various fancy dishes. The tubers may be dug as wanted during the winter, and ordinarily enough of the plant will be left in the ground to propagate it the following year. The greatest fault with the vegetable is the fact that the tubers shrivel and spoil if exposed to the air for a few hours. This will interfere with their market qualities. They can be kept in earth, however, and the French market them in moist shavings, or in sawdust. Much of their value depends upon their crispness.

This plant has been much advertized, and as it bids fair to become a vegetable of some importance, I have collected here the experiences of various growers with it.

"The *Stachys tuberifera*, a so-called new vegetable from northern Africa [China], was tested, but cannot be pronounced a very great acquisition. It belongs to the mint family, and produces small fleshy tubers, which in our trial only attained the size of acorns. Its table qualities were not tested."—*Professor Goff, before Western N. Y. Hort. Soc. 1889, 28.* Our opinion was much the same as Professor Goff's at the close of our first season of test, but during the second year, the plants not having been dis-

turbed, the yield was wonderfully increased, and one plant yields a mess sufficient for a family of four.

"The tubers, which are the edible part, are produced in such an abundance as to be truly wonderful, as many as 300 having been grown from a single tuber in one season. * * * Their uses and best modes of preparation for the table are not yet known. We find by mashing them and preparing as we do egg-plant, that they closely resemble the latter, having that pleasant, spicy characteristic flavor; and as they are as easily kept as potatoes, it is a real treat to have this very good substitute in the winter. They are also good when fried or roasted."—*John F. Rupp, Pennsylvania, in Pop. Gard. iv. 122 (1889).*

"*Stachys tuberosa* is perfectly hardy in the north of France, and accommodates itself to various soils and conditions. The tubers are small, but each plant bears a great number of them, and it is very easy to harvest them. It is essentially a winter vegetable, the tubers forming late in summer and being dug in November. It is preserved anywhere under the soil, and is not injured by the frost of winter."—*Chas. Naudin, in Manuel de l'Acclimeteur, 507 (1887).*

"A year ago the Dutch horticultural journal *Sempervirens* asked for reports upon *Stachys tuberosa* for European cultivation as an article of food. Twenty-one reports were submitted, among which seventeen were favorable, recommending the plant as a valuable addition to the list of table vegetables. Good sandy soil, not too dry, is said to be the best for it, as the tubers then become beautifully white, while in heavier soil they assume a brownish color."—*Gard. and Forest, ii. 144 (1889).*

"The new vegetable * * * seems to be winning its way in Germany. It was put to proof in the proverbial way at a recent meeting of the Society for the Promotion of Horticulture in Berlin, being eaten both boiled and roasted. Some who tested it pronounced roast potatoes much better, but the majority, says a German journal, declared that the stachys tubers have a 'fine, peculiar taste, and should be highly recommended to the epicure'."—*Gard. and Forest, ii. 600.*

"The new vegetable, *Stachys affinis*, has become quite popular in France, and is found now in all the principal fruit shops in Paris, the price varying from twelve to twenty-five cents a pound.

At Amiens, one of the principal centres of production, it has been sold for fifteen francs [about \$3] a hundred pounds. Some one in that city conceived the happy idea of making a preserve of the tubers. Prepared in this way they lose nothing of their quality, and the question of keeping them is settled.”—*Gard. and Forest*, ii. 624.

“I have now grown this new vegetable * * * for several years, and find it well worth extensive cultivation. It is much esteemed as a second course vegetable, and it is also a useful ingredient in the salad dish, looks well, and is very palatable as a pickle, and is a fitting companion to the breakfast radishes. * * * The yield is quite a bushel to about 16 square yards.”—*P. Middleton, Gard. Chron.* 3 ser. iii. 211 (1888).

“Where stachys has once been planted, there is always a difficulty in ridding the land of them, and it is as troublesome as couch-grass.”—*W. A. Cook, in Gard. Chron.* 3 ser. viii. 667.

The following account of forcing the plant is interesting : “Sets [tubers] were planted in 12-inch pots in December, the temperature maintained being 50° to 55°. I have also grown it in cold frames, with good result, having as many as 100 tubers on one plant.”—*J. Claydon, in Gard. Chron.* 3 ser. iii. 469.

Several chemical analyses of this vegetable have been made, as follows :

Lhôte : *

Starch	17.80 per cent.
Albumen (including 0.69 N)	4.31 “
Fatty matters	0.55 “
Woody matters and cellulose	1.34 “
Mineral matters (including 0.28 phosphoric acid)	1.81 “
Water	74.19 “

100.00

Pailleux and Bois :

“The analysis given shows 78 per cent. of water, 1.50 of nitrogenous matters, 1.67 of amides, and 16.5 per cent. galactane—a newly discovered carbohydrate—a substance allied to dextrine, and intermediate between starch and sugar. In the dry state the percentage of this substance is stated to be as high as 76.7, so that the nutritive value is high, particularly as the proteic matters are cited as 6.6 per cent.”†

* Reported by Carrière, *Revue Horticole*, lvii. 237 (1885); also in *Gard. Chron.* 3 ser. iii. 16 (1888).

† *Gard. Chron.* 3 ser. vi. 164 (1889), abstr. from *Revue des Sci. Nat. Appl.*

Church :

" It appears that they contain 78 per cent. of water, 1.5 per cent. of albuminoids, 1.7 per cent. of non-albuminoids or amides, 16.6 per cent. of sugars, .7 per cent. of fibre, .1 per cent. of ash, .2 per cent. of fat, and a trace only of starch."*

Planta:†

	Fresh.		Dry.
Water.....	78.33 per cent.		
Protein.....	1.50 "	.....	6.68 per cent.
Amides	1.67 "	.....	7.71 "
Fat (ether extract).....	0.18 "	.....	0.82 "
Nitrogen-free extract.....	16.57 "	.....	76.71 "
Crude fiber.	0.73 "	.....	3.38 "
Ash	1.02 "	.....	4.70 "
Dry substance	21.67 "		100.00

At Cornell :

Water, 78.9 per cent.

Protein, 12.04 per cent.

Ash, 1.09 per cent.

The phosphoric acid, potash and lime are present in the ash as follows :

P₂ O₅ .19 per cent.

K₂ O .64 "

Ca O .03 "

All these analyses show that chorogi rates fully as high as potatoes in food and fertilizer value.

From the foregoing experiences, it appears to be safe to recommend the chorogi for trial in every home garden.

* Before Royal Hort. Soc. Reported in Gard. Chron. 3 ser. iv. 708 (1888).

† Landwirtsch. Versuch-Stat. xxxv. 478 (1888).

NOTE.—Aside from the references given in this article, the student may find the following discussions of the species : Franchet and Savatier, *Enum. Pl. Jap.* i. 379. Maximowicz, *Bull. Soc. Imper. Nat. Moscow*, liv. 46 (1879). Pailleux and Bois, *Bull. Soc. Nat. d'Acclimation de France*, 1884, 44 and 280; 1885, 196; 1889, 580 and 634 (illustr.). *Revue Hort.* 1885, 236; 1887, 266 (illustr.). *Bull. Soc. Tosc. Ort.* 1886, 68 (illustr.) *Le Jardin*, 1887, 8 (illustr.). Franchet, in *Mem. Soc. Sci. Nat. Cherbourg*, xxiv. 243. Dammer, in *Humboldt*, May, 1888. Dufour, in *Chronique Agric. et Viticole du Canton de Vaud*, Apr. 1888. Vöchting, in *Botanische Zeitung*, xvii. 502, 1889 (illustr.). *Gard. Mag.* 1888, 779. Sahut, in *Ann. Soc. Hort. et Nat. Hist. Hérault*, xxii. 46 (1890).

SPANISH SALSIFY.—*Scolymus Hispanicus*, Linn.

A vegetable which promises to be of considerable value in this country, if once generally introduced, is the so-called Spanish salsify, a native of southern Europe. I have grown this for two years. It makes a root much like salsify, except that it is much lighter colored and considerably longer. Its flavor is less pronounced than that of the salsify, but when carefully cooked it possesses a very agreeable quality which is somewhat intermediate between that of the salsify and parsnip. It is adapted to all the methods of cooking employed for those vegetables. The particular value of the vegetable, aside from affording a variety in the kitchen garden, is its large size and productiveness as compared with the salsify. We raise almost twice the crop upon a given area than we can secure from salsify, and no doubt it could be sold for that vegetable in the

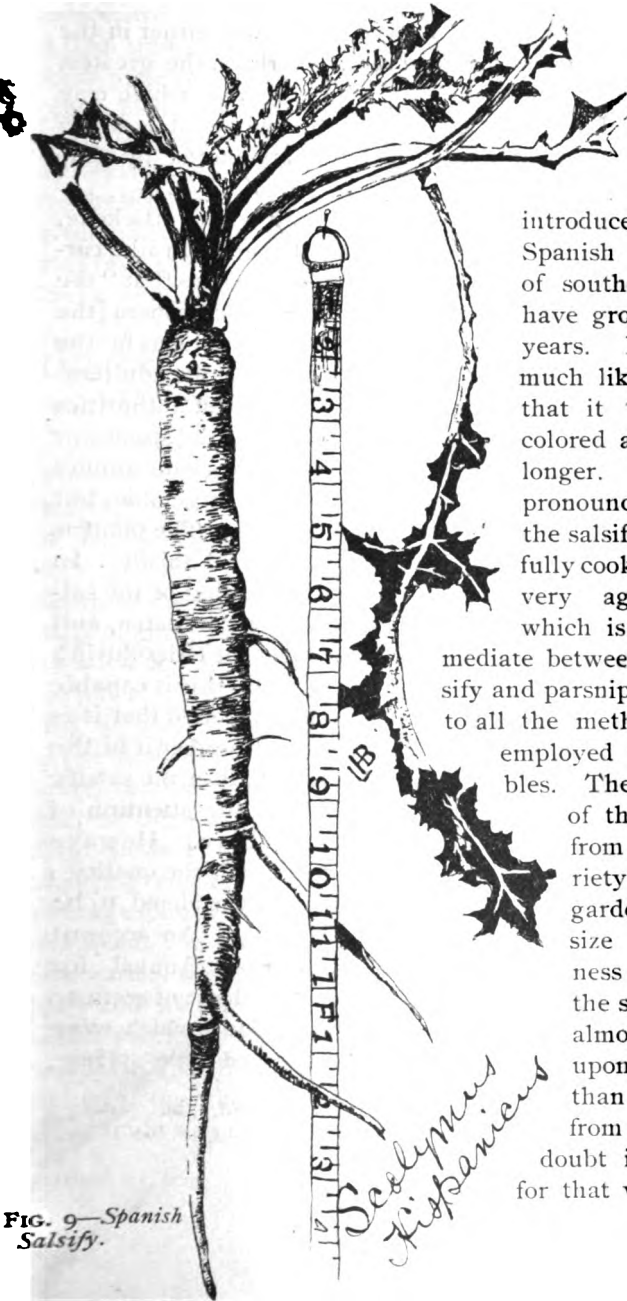


FIG. 9—Spanish Salsify.

general market. The seeds are much easier to handle and sow than those of the salsify. It is sown and cultivated in exactly the same manner as that vegetable, and can be dug either in the fall or spring. Fig. 9 shows a good root. Perhaps the greatest disadvantage of the plant is the very prickly leaves, which may make it unpleasant to handle. But on the whole, it is worth introduction into American gardens. Seeds are offered by some American seedsmen.

Spanish salsify is closely allied to the cardoon and artichoke, and its young leaves are sometimes bleached and eaten like cardoons. Nicholson, in Dictionary of Gardening,* writes that "the roots of *Scolymus Hispanicus* are equally as good as scorzonera [the black salsify]; the leaves and stalks are eaten as cardoons by the people of Salamanca; the flowers are employed for the adulteration of saffron." Naudin, who is one of the highest authorities upon cultivated plants, makes these remarks about the species: † "It is a compositous biennial of the Mediterranean region, common in the middle of France and Spain, utilized as a vegetable, but cultivated only in Spain, especially about Madrid. The plant is spiny and has the appearance of a yellow-flowered thistle. In France only the root is eaten, and this resembles that of the salsify; in Spain the midribs and petioles of the leaves are eaten, and these are sold in great quantities upon the streets of cities during many months of the year. As with other plants, this is capable of amelioration by cultivation, and it is to be regretted that it is neglected in France and that people are content to gather it in the wild state. The root is a better vegetable than that of the salsify or the scorzonera." The plant was brought to the attention of American gardeners nearly thirty years ago by Burr.‡ He gave directions for its cultivation, and wrote as follows of the quality: "They have a pleasant delicate flavor and are considered to be not only healthful, but remarkably nutritious." An account of it is given in the American Horticultural Annual for 1871, and the following remarks are made: "It does not seem to be quite as hardy as the salsify, some of our plants which were left out for experiment being found partly decayed in the spring.

* Vol. iii. 394. See also Vilmorin's Veg. Garden (Eng. ed.) 249.

† Manuel de l' Acclimateur, 491 (1887).

‡ Vegetables of America, 87.

The root is considerably larger than the salsify, and less trouble to prepare, does not require so much care in cooking to prevent it from turning dark-colored, and has a milder flavor, which is by some preferred to that of the salsify. On the other hand the plant, being prickly, is somewhat unpleasant to handle, the roots being longer and more brittle are more difficult to dig, and the center is somewhat fibrous. The last named difficulty is overcome by the French by first boiling the roots, then splitting them longitudinally and removing the tough center, which readily separates from the outer portion, which is very tender." We have not found tough centers in our plants.

THE INFLUENCE OF THE DEPTH OF TRANSPLANTING UPON THE HEADING OF CABBAGES.

For three consecutive seasons we have endeavored to determine what foundation there may be for the common notion that deep-set cabbage plants give better heads and a larger proportion of heads than those set at the normal or natural depth. It is a very general practice among gardeners to set the plants to the depth of the first leaf when transplanting to the field. The results of three years' tests show that no advantage is to be gained by such practice. In 1889* the experiment was tried upon 12 varieties, about 20 plants of each being set up to the first leaf, and as many more set to the same depth at which they stood in the seed-bed. Strangely enough, one-half the varieties gave better results from shallow setting and the other half better from deep setting. There were more heavy heads from the deep setting, however: 270 cabbages gave better results from shallow planting and 295 heads better from deep planting. The total average gain in weight apparently due to deep setting was 2 oz. per head. These 12 varieties were distributed into 13 lots—that is, one variety was grown twice,—and of these, three lots were sown July 2nd. for a late crop. Two of these three late sowings gave better results from deep setting, but the third lot, which gave better results from shallow setting, gave a greater increase in weight than either of the others. Combining all the results, it was found that the gain in weight of heads from deep setting was as 13.60 is to

*Bull. xv. 209.

13.46. This is a very small gain, and when studied in connection with the many conflicting results among the different lots, leads to the conclusion that the particular method of planting probably had nothing to do with the yields, for variations equally as great, and many times much greater, come from lots treated in the same manner.

In 1890* the test was repeated, the Early Wakefield cabbage being used for the purpose. The plants were grown upon a heavy and rather poor clay loam. The numerical results were as follows :

	Total no. of plants.	No. of mature or solid heads.	Per. cent of pls. pro- ducing mature hds.	Average weight per. hd.
Deep	107	82	77	1.6 lbs.
Shallow	104	89	85	1.8 lbs.

Here the shallow planting gave decidedly the better results, both in the percentage of plants producing good heads and in the average weight of heads.

In 1891 the test was again repeated, this time with Early Wakefield and Premium Drumhead. The plants were grown on a rich and well prepared loose clay loam, and all the conditions throughout the season were such as to insure a fair and uniform test. The results of this test are the following :

	Total no. plants.	No. of mature heads.	Per cent. of plants pro- ducing mature hds.	Average. weight per head.
Early Wakefield—Deep.....	71	70	98.6	4.26 lbs.
Shallow.....	61	55	90.6	4.24 "
Premium Drumhead—Deep..	30	29	96.6	5.19 "
Shallow.....	45	45	100.	5.37 "
Average—Deep.....			97.6	4.72
Shallow			95.3	4.80

The average result is in favor of the shallow setting so far as weight of heads is concerned, but in favor of deep setting in the percentage of plants producing good or mature heads; but the differences are slight, and are such as might be expected from two or more lots of plants treated in the same manner. The two varieties give different results, however. The Early Wakefield gives the better results from deep setting, while the Drumhead gives better results from shallow setting. In view of these con-

* Bull. xxv. 178.

flicting results, I cannot look upon the differences as due to the manner of setting.

In conclusion, we find, as a result of three years' investigation, that the depth at which strong and stocky cabbage plants are set does not influence the extent or weight of the crop.

THE VERBENA MILDEW.

The verbenamildew (*Oidium erysiphoides*), which is often very destructive to house-grown plants, has been held in check in our houses by the use of sulphide of potassium ($\frac{1}{4}$ oz. to a gallon of water). A lot of thrifty and stocky young plants which were badly attacked was divided into two lots for treatment, the lots being placed in separate houses. The treated plants received a spray of the sulphide about twice a week, and although a little of the mildew could always be found, the plants were not injured. The check lot was ruined, and the plants died. It is probable that copper compounds, as the ammoniacal carbonate of copper, will be found still more effective, but our simple treatment was so successful that we found no occasion to try any other. This mildew appears upon the leaves and young shoots in white mold-like patches.

L. H. BAILEY.

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June, 1892.

Cornell University Agricultural Experiment Station.

HORTICULTURAL DIVISION.

THE CULTIVATED NATIVE
Plums and Cherries.



By L. H. BAILEY.

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BULLETINS OF 1892.

38. The Cultivated Native Plums and Cherries.

THE CULTIVATED NATIVE PLUMS AND CHERRIES.

I. THE PLUMS.

§ 1. CLASSIFICATION OF THE CULTIVATED NATIVE PLUMS.

- A. The Americana Group.
- B. The Wild Goose Group.
- C. The Miner Group.
- D. The Chickasaw Group.
- E. The Marianna Group.
- F. The Beach Plum.
- G. *Prunus subcordata*.
- H. Hybrids.
- I. Unclassified Varieties.

§ 2. CULTIVATION OF THE NATIVE PLUMS.

- 1. Impotent Varieties. Planting.
- 2. Propagation.
- 3. Varieties.
- 4. Insects and Diseases.

Since the introduction of the Wild Goose plum some forty years ago, there has been a steadily growing interest in the amelioration of our native plums. The native species possess certain advantages over the common plums of the *Prunus domestica* type,* and they are so widely distributed and are naturally so variable that they have been easily brought into cultivation under a great number of forms. Over 150 varieties have been named and more or less disseminated, and the following pages record 140.

* The common plums and the pñunes belong to the European species *Prunus domestica*. In the following pages these fruits are often referred to as the *domestica* plums.

There has been no attempt, so far as I know, to make a comprehensive study of these fruits, and as a consequence our knowledge of them is vague and confused. In fact, the native plums constitute probably the hardest knot in American pomology. The botanical status of the native plums is equally unsatisfactory, and the group is one of the most inextricably confused of any one of equal extent in our whole flora. There are few botanical features which are reliable in the characterization of the species, and the specimens which are preserved in the leading herbaria are few and unsatisfactory. There is probably no group of American plants in which the characters of growing trees and fresh fruits are more essential in the distinguishing of species than in these plums. Yet there are the most remarkable variations in habit of tree, seasons of blooming and ripening, size, flavor and texture of fruit, and characters of stone, even among varieties coming presumably from the same species. Fully half of the varieties now in cultivation were picked up in woods and copses and transferred to the orchard, and the variations between these varieties are fully as great as between those of known or garden origin. There is evidence that hybridity is responsible for some of the variation of cultivated forms, but whether it takes place in nature is wholly a matter of conjecture. It is an unsafe principle to invoke the aid of hybridity, upon purely speculative grounds, to explain doubtful points; and I have therefore referred doubtful forms directly to the most closely allied species or type, so far as possible, leaving speculations as to their true affinities to future students. The native plums can be commended with confidence to any one who desires to study contemporary evolution.

In the following study, which has now extended through six years, I have had the co-operation of many botanists and horticulturists. I am under especial obligations to all those whose names are mentioned in this paper, particularly to J. W. Kerr, Denton, Maryland, and T. V. Munson, Denison, Texas. Without the aid given by these last two persons the preparation of this monograph would have been impossible. Mr. Kerr probably has the largest growing collection of native plums in existence, and I have had the advantage of a personal inspection of his orchards

in the fruit season. I have had access to the herbarium collections at Harvard University, Columbia College, Department of Agriculture, and the Engelmann Collection of the Missouri Botanical Gardens. Several botanists have favored me with material, especially Dr. C. E. Bessey, University of Nebraska, Dr. T. C. Porter, Easton, Penn., and H. N. Patterson, Oquawka, Illinois. And I have enjoyed the great advantage of having had the advice of Professor C. S. Sargent, who has critically examined some two or three hundred of our specimens. In the following descriptions, those varieties marked C are in cultivation at Cornell.

§ 1. *Classification of the Cultivated Native Plums.*

A. THE AMERICANA GROUP. (*Prunus Americana*, Marshall, *Arbustrum Americanum*, III, [1785]).

To this type belong the hardy, strong growing varieties which have come from the northwest, and which are characterized by a firm, meaty, usually compressed, dull-colored late fruit, with thick and usually very tough, glaucous skin, and large more or less flattened stone which is often nearly or quite free, and by large obovate, thick, veiny, jagged, dull leaves. *Prunus Americana* is generally distributed throughout the Northern States from Western New England to Kansas and Nebraska, and to the mountains of Montana and Colorado, in the middle longitudes reaching as far north as Manitoba and as far south as Texas and even northern Mexico. Notwithstanding its wide range, most of its cultivated varieties have come from its northwestern limits, as northern Illinois, Wisconsin, Minnesota, Iowa and Kansas. This fact is indication that the western plum may be a distinct species from the eastern and southwestern types, and I should not be surprised if we ultimately find this to be true. I have looked in vain, however, for characters with which to separate them. Professor Sargent is of the opinion that the *Prunus nigra* of Aiton should be revived to designate those forms which are characterized by very flat and smooth stones, very broad leaves, glandular leaf-stalks and calyx lobes, and large flowers. To this species he would refer the Weaver, the stones of which, as shown in Fig.

1, are very large, flat and smooth. After the most careful study, however, I am unable to find any constancy in these characters, especially in cultivated varieties. Even in wild specimens, the flat stone of *P. nigra* is often associated with the glandless leaf-stalks of *P. Americana*, and *vice versa*; and there appears to be equal inconstancy in the characters of calyx lobes and sizes of flowers. In fact, the same cultivated variety, when grown in different places, has been referred to both species. I am obliged, therefore, for the purposes of this paper, to unite *Prunus nigra* with *P. Americana*. This I regret the more because it is undoubtedly true that there are two well marked wild varieties—possibly species—passing as *P. Americana*, and growing together in the East. One is a twiggy, virgate grower, with large and mostly earlier flowers; the other is a stout and stiff grower with small flowers. So far as I have been able to determine, the fruits and stones of these two forms, save possibly in time of ripening, are not characteristically distinct. These forms are certainly common in central New York and in Michigan, where I have often observed them. Dudley records them in Cayuga Flora.* Some of these differences are detailed in the following letter from Professor Charles A. Davis, of Alma, Michigan, accompanying specimens of the trees mentioned. The specimens were referred to Professor Sargent, who places the first or large-flowered form with *P. nigra* and the small-flowered form with *P. Americana*. "The large-flowered form is the more common and blooms about a week or even ten days before the other, and usually before the leaves begin to appear. The small-flowered form I have never found until this spring, when I came upon a clump of it in full bloom, and at once became interested in it because of its decided differences from the other and common form. The trees were larger, more spreading, and with a much rougher bark than the large-flowered form; and a number of the trees bore flowers with a decidedly yellowish tint, which was very noticeable from a short distance. The fruit was late, maturing the middle of September, and was reddish, almost purple in very

* The Cayuga Flora, Ithaca, N. Y. 1886, p. 27. See also Flora Chicago.

ripe specimens, with a whitish bloom, small and rather palatable." It is easy to place too great confidence in the seasons of blooming and ripening, for these characters are variable. This is well illustrated in the case of the Late Rollingsstone plum, which is a seedling from the Rollingsstone—itself a wildling—but which is three weeks later in ripening than its parent.

The fruits of wild forms of *Prunus Americana* vary widely in season, size, shape, flavor, and character of stone. Trees in the same clump often vary two weeks in season of ripening of fruit, which may vary from dull deep red to yellow. It should be said, however, that there is no true clear yellow fruit in this species. The yellow of *P. Americana* is always a more or less ill-defined under color, over which are laid blotches of red. The fruits are more or less flattened, as is well shown in Fig. 1, usually oblong and truncate or somewhat flattened at the ends, and are commonly marked with a distinct suture. All the varieties have a light purple bloom.

The Texan form of *P. Americana*, known locally as the Hog plum, appears to differ somewhat from the northern forms, and it may be a distinct species. It has the glands, both of calyx and leaf-stalks, of the *P. nigra* form and the rounded stones of true *P. Americana*. The plant is not in cultivation, however, and need not be further discussed here.

Prunus Americana was founded over a century ago by Humphrey Marshall. His description, particularly of the leaves, is peculiarly characteristic of the wild plum of the north. It is as follows :

"*Prunus Americana*. Large Yellow Sweet Plum. This generally rises to the height of 12 or 15 feet, spreading into many stiff branches. The leaves are oblong, oval, acute pointed, sharply sawed on their edges and much veined. The flowers generally come out very thick round the branches, often upon thick short spurs; and are succeeded by large oval fruit with a sweet succulent pulp. We have a great variety of these, growing naturally in a good moist soil, with reddish and yellowish fruit, but differing much in size, taste and consistence."

West of the Mississippi there is a form of *Prunus Americana*

with conspicuously pubescent and often glaucous leaves and shoots. This is the variety *mollis*, a plant which is commonly supposed to be confined to Texas and its northern borders. It certainly grows as far north as Iowa. The varieties known as Wolf and Van Buren belong here.

The following cultivated varieties belong to *Prunus Americana*:

1. *American Eagle*.—Fruit and flowers unknown to me. Leaves rather large, the stalks glandular. Introduced in fall of 1889 and spring of 1890 by Osceola Nursery Co., Osceola, Missouri. C.

2. *Beaty's Choice*.—Fruit large, round-oblong, red-purple or red-blue, skin medium thick: flesh firm, of high quality: cling, the stones broad, flat and smooth, like those of Weaver; flowers large, conspicuously stalked in large clusters, calyx lobes reflexed, glandless, smooth or nearly so on the inside. Late. Originated under cultivation in Southern Texas by Lee Beaty. T. V. Munson says that it appears to be a hybrid between *Prunus Americana* and *P. domestica*. Ripens at Denison, Texas, from the first to the middle of August.

3. *Black Hawk*.—Known to me only from a record in Bull. 4, Iowa Experiment Station, by R. P. Speer (Feb., 1889), in which "a nameless variety found in Black Hawk County, and a very large and beautiful free-stone plum, which was furnished by Mr. Slater of Story County," was tested as to culinary qualities in comparison with Miner, Weaver, Bassett, Rollingstone, Moreman, Wolf, De Soto and Maquoketa. "The decision of all who tasted the same was that the Maquoketa and Black Hawk plums were equally good and much better than any of the other kinds except the De Soto, which was marked good, but second in quality. The skins on the Maquoketa and Black Hawk plums were so thin that they disappeared almost entirely while being cooked." I do not know that the variety has been introduced. Presumably *P. Americana*.

4. *Brainerd*, in cultivation in Minnesota (O. M. Lord), probably belongs to this species.

5. *Cheney*.—Fruit large to very large, round-oblong, scarcely flattened, dull purplish red, skin thick: flesh firm and sweet, good to very good: cling, the stone very flat and smooth with rather rounded ends; flowers not large, the calyx lobes glandular, smooth inside; leaves medium, long-pointed, leaf-stalks glandular. Early for the group, ripening even in Minnesota by the middle of

August. One of the best varieties. Found in Morman Ravine, a few miles below La Crosse, Wisconsin, and introduced by E. Markley, La Crosse. C.

6. *Chippeway*.—Fruit small to medium, oblong, deep red, the skin medium thick: flesh firm and sweet: stone free, small, strongly convex on the sides and pointed, roughish; leaves medium, rather strongly pubescent beneath, leaf-stalks glandular. Has gained no prominence so far as I know.

7. *Cottrell*.—Fruit large, round-oblong, red, skin thin: flesh rich and agreeable: cling; leaves large, comparatively thin and smooth, leaf-stalks glandular. Medium season. Seedling raised by R. L. Cottrell, Dover, Olmsted Co., Minn., and introduced in 1888 by O. M. Lord of Minnesota City.

8. *Deep Creek*.—Medium size, round-oblong and prominently flattened and bearing a conspicuous suture, dull purple-red, very glaucous, skin thick: flesh firm, and very sweet and good: stone free, sides convex, long-pointed, roughish; flowers rather small, short-stalked, the calyx lobes glandless and hairy inside; leaves medium, nearly smooth, stalks glandular. Medium season. A Kansas wild variety, introduced by Abner Allen. C.

9. *De Soto*.—Large to very large, round-oblong, purple-red with moderate bloom, skin thick: flesh medium firm, good: stone cling, rather large, somewhat convex, rounded at the ends, slightly roughened; leaves medium, stalks glandular. Medium to late. One of the most popular varieties. Found wild on the Mississippi at De Soto, Wisconsin. Generally introduced by Elisha Hale, Lansing, Iowa, 1863 or 1864. Figured by Professor S. B. Green in Bull. 5, Minn. Exp. Sta. See No. 3, above. C.

10. *Forest Garden*.—Large, round, orange overlaid with rose-purple, skin medium thick to thin: flesh medium firm to soft, good: stone cling, convex on the sides, rounded at the ends, slightly roughened; leaves medium, rather smooth, glands none or reduced to a single small one. Medium season, ripening in Minnesota the middle of September. A good sort for home use, but does not ship well unless picked before ripe. Tree grows forked and is apt to split. Said not to succeed well east of Illinois. Taken from the woods at Cedar Rapids, Iowa, by Thomas Hare, and introduced by H. C. Raymond, of the Forest Garden nurseries, Council Bluffs, about 1862. Figured in Bull. 5, Minn. Exp. Sta., by Prof. S. B. Green.

11. *Gaylord*.—Fruit large, round-oblong and slightly flattened, deeply mottled red over a ground of orange, skin rather thick: flesh pulpy and sweet: stone moderate cling, broad and rather flat,

pointed, sharp-edged on the back, somewhat roughened; leaves rather broad, somewhat pubescent below, glandular. Medium season. Introduced recently by Edson Gaylord, Nora Springs, Iowa.

12. *Harrison's Peach*.—Medium size, round-oblong, dull red, skin thick: stone free; leaves medium, rather thick and pubescent, the glands large. Medium season. Not widely disseminated apparently. Minnesota, a wild variety. C.

13. *Hawkeye*.—Large to very large, round-oblong, purple-red, skin thick: flesh firm and good: stone cling; leaves medium firm, very smooth for the species, stalks glandular. Medium season. Originated in Iowa under cultivation. Introduced by H. A. Terry, Crescent City, Iowa, 1878. Specimens from the Michigan Agricultural College evidently belong to *Prunus angustifolia*, the Chickasaw type. C.

14. *Ida*.—I know this only from a description submitted by D. B. Wier, the originator: "Medium size, round, yellow nearly covered with dull red: flesh firm, salmon-color, very sweet: free-stone; leaves very downy and leathery; tree thorny, exceedingly sprawling. The fruit is acid when cooked, but dries sweet." Said by Mr. Wier to be pure *P. Americana*. Illinois.

15. *Illinois Ironclad*.—Fruit very large, oblong, dark red, thick skin: flesh firm: cling; leaves medium, pubescent, glands small or absent. Medium season. Said to be one of the best native plums. Wild variety from Illinois, introduced in 1890 by Stark Bros., Louisiana, Mo. C.

16. *Iona*.—Known to me only from description of the originator, D. B. Wier: "Fruit large, oblong, dull yellow with red cheek, skin medium thick: flesh firm, yellow and sweet: stone free, long and much flattened, with a sharp border on the back; leaves very large; tree strong and upright, the growth smooth. Medium season." Said by Mr. Wier to be pure *P. Americana*, the seed coming from a wild bush in southwestern Wisconsin.

17. *Itaska*.—Fruit medium, oblong, dull purple-red, skin thick: flesh firm, of fair quality: cling; flowers small and sessile, pinkish, the calyx lobes somewhat glandular, and smooth within; leaves thick and broad, stalks either glandular or glandless; tree a very short, stocky and thick grower, the short joints giving the pinkish bloom a strikingly massed effect. Medium season. One of the most distinct in habit. Minnesota. Introduced by P. M. Gideon, Excelsior, Minn., and by W. F. Heikes.

18. *Kickapoo*.—Medium, round-oblong, blotched red, thick skin: flesh firm: stone cling, convex on the sides, long, roughish

flowers small and sessile or nearly so, calyx lobes minutely glandular and smooth or nearly so within; leaves rather small, narrow, long-pointed, very sharply toothed, pubescent below, glandless or occasionally a leaf with small glands; tree a straggling grower, very prolific. Medium season. Appears to be much attacked by shot-hole fungus.

19. *Kopp*, introduced by O. M. Lord, Minnesota, is probably *P. Americana*.

20. *Late Rollingstone*.—Very like Rollingstone (No. 35) of which it is a seedling, but three weeks later, pulp not so firm, and skin thicker. O. M. Lord, Minnesota.

21. *Le Duc*.—Medium, round and flattened, orange spotted with red, skin thin: flesh pulpy and sweet: a moderate cling, the stone rather broad with convex sides, rounded at the ends, slightly roughened. Medium season. A wild variety from Hastings, Minn., introduced by W. G. Le Duc. C.

22. *Little Seedling*.—A small red plum with small convex roughish cherry-like stones, and narrow, rather finely serrate leaves, and glands very small or none. Charles Luedloff, Carver, Minn.

23. *Louisa*.—Large to very large, round, deep red, skin thick: flesh firm and good: semi-cling, the stone broad and convex and smoother than is usual for this shape; leaves medium, long-pointed, pubescent below, glands small or none. Medium season. A wild plum found in Missouri and introduced by Samuel Miller, Bluffton, Mo. "Very similar to Weaver."—*T. V. Munson*. Flowers upon Maryland specimens are small and nearly sessile, with glandless calyx; from Texas they are large and stalked, with calyx lobes reflexed and glandular, and hairy within.

24. *Luedloff's Green*.—Medium to small, oblong and flattened, deep mottled red, skin thick: flesh firm, sweet and good: nearly free, the stone small, convex, pointed, rough; leaves rather small and smooth, glands very small or none. Charles Luedloff, Minn.

25. *Luedloff's Red*.—Much like the last, but lighter red, skin thicker, pit freer, stone rather broader and leaves pubescent beneath.

26. *Maguoketa* (Fig. 11).—Medium to nearly large, round-oblong, red, skin thick: cling, the stone very convex, short-pointed, rough; leaves medium, rather smooth, glands none or small. Medium to late. Originated in Iowa under cultivation. See No. 3.

27. *Minnetonka*.—Medium in size, round-oblong, dull red, skin thick : cling ; flowers medium, calyx lobes glandless, hairy inside ; leaves medium, pubescent, glandless or nearly so. Medium season. Introduced by P. M. Gideon, Minn.

28. *Mussey*.—Very large, round-oblong, yellow mottled with red, skin medium thick : flesh firm and excellent : semi-cling ; leaves medium to large, pubescent, glands small or none. Very late. Wild, from Kansas. Introduced by Abner Allen.

29. *Newtown Egg*.—Medium to rather large, oblong, red, skin thick : flesh firm : free, the stone long and rather flat, scarcely pointed, nearly or quite smooth ; leaves medium, nearly smooth, glands none or small. Medium season. Charles Luedloff, Minn.

30. *New Ulm*.—"Very large, round-oblong, dark red, skin medium : flesh firm and of best quality : cling. Medium to early. A Minnesota seedling introduced by C. W. Heideman, New Ulm, Minn."—*Professor S. B. Green, Minn. Exp. Sta.* Presumably *P. Americana*.

31. *Ocheeda*.—"Large, round, yellow and red, skin thin : flesh firm and of best quality : semi-cling. Medium season. Wild variety from Minnesota. Introduced by H. J. Ludlow, Worthington, Minn."—*Professor S. B. Green, Minn. Exp. Sta.* Presumably *P. Americana*.

32. *Peffer's Premium*.—Medium to nearly large, round, red, skin thick : flesh firm and good : cling, the stone nearly circular and flat, rather smooth ; leaves medium with rather obtuse serratures, nearly smooth, stalks glandular. Medium season. Wisconsin seedling. Introduced by George P. Peffer, Pewaukee, Wis

33. *Purple Yosemite*.—Very large, round, red-purple, skin thick : flesh firm : cling, stone large and flat, blunt at the ends and on the margins, nearly or quite smooth ; flowers medium, short-stalked, the calyx lobes glandless and hairy within ; leaves medium, comparatively smooth, stalks glandless or glands small. Medium season. An excellent plum in many places. C. M. Stark writes me that it has no value in Missouri. C.

34. *Quaker*.—Very large ($1\frac{1}{2}$ in. long), round-oblong and somewhat flattened, purple-red inclining to orange-red on side opposite the sun, very glaucous-blue, skin very thick and acerb : flesh very firm, sweet and juicy : moderate cling, the stone large and flat, prominently ridged and winged on the back, ends rather blunt, slightly pitted ; flowers rather large, stalked, the calyx

lobes large and becoming reflexed, hairy inside but scarcely if at all glandular; leaves rather large and firm, pubescent, the glands small or sometimes wanting. Medium season. One of the best varieties. Must have the best cultivation and not be allowed to overbear. Discovered wild by Joseph Bundy, of Springville, Linn Co., Iowa. Disseminated about 1862 by H. C. Raymond, Council Bluffs, and by him named Quaker in compliment to Mr. Bundy, who is a quaker. C.

35. *Rollingstone*.—Very large (often $1\frac{1}{2}$ in. each diameter), round, flattened and truncate at the ends, mottled and spotted pink-purple, skin very thick: flesh firm, sweet and excellent: semi-cling, stone nearly circular, rather flat, sharp on the back edge, nearly smooth; flowers large, long-stalked, the calyx lobes large and rarely somewhat glandular, hairy on the inside; leaves large and firm, comparatively smooth, stalks either glandular or glandless. Medium season, coming in just before De Soto. One of the leading varieties. Found over 30 years ago on the bank of the Rollingstone Creek, Winona Co., Minn., by O. M. Lord, and by him introduced some ten years ago. Professor L. H. Pammel, of the Iowa Agricultural College, writes me that this variety is reported as the common plum along creeks at Dysart, Iowa. C.

Mr. Lord has raised many pure seedlings of the Rollingstone, of which the Late Rollingstone (see No. 20) is one. "Several years ago," he writes, "I cut out of my grounds all varieties of native plums except the Rollingstone. The object was to perpetuate the tree by seeds true to name by preventing all crossing. Some of the seedlings cannot be distinguished by their foliage or flowers, but none of them bear as good fruit as the parent. Some are later and some earlier." The variety is figured by Professor S. B. Green in Bull. 10, Minn. Exp. Sta.

36. *Speer*.—Medium, oblong, mottled orange and red, skin medium: flesh firm and sweet: semi-cling, stone broad, convex, ends blunt, slightly roughened; leaves medium, nearly smooth, stalks glandular. Iowa seedling by J. A. Speer.

37. *Van Buren* (*Prunus Americana* var. *mollis*).—Large, round-oblong, purple-red, skin thick: free; leaves medium, densely white pubescent beneath and on the stalks, as well as the young growth, stalks glandular. Medium season. The pubescence is most marked on young shoots. An Iowa wild variety, introduced by J. Thatcher.

38. *Wazata*.—Medium or even small, round, dull red, thick skin: cling; leaves medium, pubescent beneath, the glands small

or none. Medium to late. C. M. Stark writes that it has no value in Missouri. Wild Minnesota variety, introduced by Peter M. Gideon and W. F. Heikes.

39. *Weaver* (Fig. 1).—Large, round-oblong and flattened, suture prominent, orange densely overlaid with mottled red, skin thick : flesh firm, sweet and good : semi-cling, the stone large and flat, obscurely pointed, the wing or margin conspicuous, smooth ; flowers large and prominently stalked, the calyx lobes usually conspicuously glandular and obscurely hairy inside ; leaves large and firm, deeply toothed, slightly pubescent beneath, the glands rarely prominent and frequently entirely wanting ; tree a strong free grower and prolific. Medium to late, ripening in Minnesota the last of September. A well marked variety, and one of the best. A wild variety, found near Palo, Iowa, by Mr. Weaver ; introduced by Ennis & Patten in 1875. Ripens in Northern Texas from the first to middle of August. O. M. Lord writes me that "the Weaver is wild in profusion on the St. Peter or Minnesota River." Figured by Professor S. B. Green in Bull. 5, Minn. Exp. Sta. C.

40. *Wier's Large Red*.—"A round plum as large as Wild Goose and better in quality, excellent for cooking ; ripening last half of September."—B. O. Curtis, *Paris, Ill.* Leaves medium, firm, smooth or very nearly so, the stalk glandular. D. B. Wier, Illinois.

41. *Wild Rose*.—"Large, round, yellow-blush, skin medium : flesh firm : cling. Early. A Minnesota wild variety, not propagated for sale, but deserving to be."—Sias. Introduced in 1880 by A. W. Sias. Presumably *P. Americana*.

42. *Wolf* (*Prunus Americana* var. *mol-lis*). Fig. 2.—Large, round, yellow blotched with red, skin thick : flesh firm, meaty and good : perfectly free, the stone circular in outline with a tendency to taper towards the apex, rather flat, the wing or border pronounced, smooth ; flowers medium, short-stalked, the calyx lobes glandular and hairy inside ; leaves broad and thick, the blades and stalks, as well as the young shoots, prominently pubescent and often glaucous, especially on the young growth, the leaf stalks bearing no glands, or only small ones ; tree a stout,

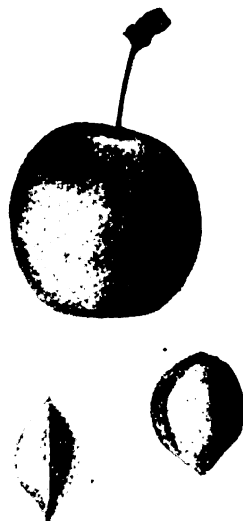


FIG. 2.—*Wolf*.



FIG. 1.—Weaver. *Foliage and flowers one-half natural size. Fruits and stones full size.*

good grower, prolific. Medium season. One of the best, both for home use and market. The illustration shows a medium sized specimen. Often known as Wolf Free. Originated on the farm of D. B. Wolf, Wapello County, Iowa, nearly 40 years ago, from pits said to have been taken from wild trees in the woods. C.

43. *Wyant*.—Large, round-oblong, purple-red, skin thick : flesh firm : free ; leaves medium, slightly pubescent, the glands small. Found wild in Northern Iowa by Mr. Wyant ; introduced by Professor J. L. Budd. C.

44. *Yellow Sweet*.—Medium, round-oblong and flattened, ground color orange mottled and splashed with pink-purple : skin thin : free, the stone nearly circular, rather flat and somewhat sharp on the back, rough. Minnesota? C.

45. *Yellow Yosemite*.—I am not acquainted with the fruit of this variety, but I am told by reliable growers that it is identical with Purple Yosemite.

The Americana group succeeds best, on the whole, in the northern states of the Mississippi valley, and it is the only one which is able to withstand the climates of the northernmost limits of the native plum belt, as Wisconsin, Minnesota and Iowa. There are some varieties, however, which succeed so far south as Texas. In the Atlantic States the varieties are not grown far south. At Mr. Kerr's place, on the Chesapeake peninsula, the varieties are likely to be unproductive, or short lived, and are much injured by a mysterious blight ; yet there are some kinds which grow well with him, among which I recall Wolf, Purple Yosemite and Kickapoo. The greatest profitable range of the group, however, is confined somewhat closely to the two or three northernmost tiers of States. The varieties which are most highly prized are Cheney, Deep Creek, De Soto, Forest Garden, Itaska, Louisa, Purple Yosemite, Quaker, Rollingstone, Weaver and Wolf.

B. THE WILD GOOSE GROUP.—(*Prunus hortulana*, L. H. Bailey, Garden and Forest, v. 90, [1892]). This, perhaps the most important group of native plums, includes varieties characterized by strong wide-spreading growth and mostly smooth twigs, a firm, juicy, bright-colored, thin-skinned fruit which is never

flattened, a clinging turgid comparatively small rough stone which is sometimes prolonged at the ends but is never conspicuously wing-margined, and by comparatively thin and firm shining, smooth, flat, more or less peach-like, ovate-lanceolate or ovate long-pointed leaves which are mostly closely and obtusely glandular-serrate and the stalks of which are usually glandular. *Prunus hortulana* in the wild state appears to follow the Mississippi river from northern Illinois to Arkansas, in its middle region ranging so far east as eastern Kentucky and Tennessee and possibly to Maryland, and in the southwest spreading over Texas.

This species does not appear to have been recognized by writers upon the genus, although pomologists have long regarded the varieties of it as distinct from *P. Americana*. As it has come into prominent notice through the labors of horticulturists, I take pleasure in recording the fact in the name *hortulana*. The varieties are intermediate between the *Americana* and *Chickasaw* groups, while the *Miner* group, which I refer provisionally to this species, is anomalous in its characters. The fruits lack entirely the dull-colored, compressed, thick-skinned and meaty characters of the *Americanas*, and approach very closely to the *Chickasaws*. They are usually covered with a thin bloom and are more or less marked by small spots. They are variable in period of ripening, there being a difference of no less than two months between the seasons of some of the cultivated varieties. In color they range from the most vivid crimson to pure golden yellow. The botanical features of the species are not yet well determined, and it is not impossible that more than one species is confounded in it. Some of the gross features of the species are well illustrated in Fig. 3.

In this group B, as I have here constituted it, there are two more or less clearly marked types, but which I am not yet able to separate by positive botanical characters. One type is characterized by thin and very smooth peach-like leaves which are very finely and evenly serrate. It comprises *Cumberland*, *Indian Chief*, *Roulette*, and *Wild Goose*. The other form or type is characterized by thicker, duller and more veiny leaves which are more coarsely and more or less irregularly serrate. This includes

Golden Beauty, Kanawha, Moreman, Reed, Sucker State, World Beater and Wayland. It forms a transition to the Miner group (C).

46. *Clark*.—A variety which I know only from the growing tree. Leaves elliptic-ovate, rounded at the base and comparatively short pointed, finely serrate, the stalks 2-glandular. Recently introduced and said to have been found wild in Anne Arundel Co., Maryland. If it is really indigenous there, it greatly extends the range of the species. C.

47. *Cumberland*.—Fruit medium, oblong, yellow, skin thin: stone rather short, rounded at the base but somewhat pointed at the apex; flowers medium, short-stalked, the calyx lobes glandular; leaves ovate, rounded at the base, long-pointed, finely serrate, the stalks bearing two to several glands. Medium to late. Said to have originated in Georgia, under cultivation. Introduced by Philip Schley. C.

48. *Garfield*.—Fruit medium, round-oblong, dark red, skin thick: stone slender (twice as long as broad), prolonged at both ends; flowers medium, stalked, the calyx lobes conspicuously glandular; leaves large to very large, ovate-lanceolate, rounded at the base, rather finely serrate, the stalks usually furnished with a string of glands; tree a strong spreading grower. Late. C. M. Stark writes that it is unproductive in Missouri. Said to have been found wild in Ohio. Introduced in 1887 by the late Leo Welz, Wilmington, O. C.

49. *Golden Beauty* (Fig. 12; also illustration on title-page).—Fruit medium, round-ovate, deep clear yellow, skin medium thick: flesh very firm and of excellent quality: semi-cling, the stone small and broad (only one-fourth larger than broad), the point very short; flowers large, prominently stalked, the calyx lobes glandular; leaves narrowly ovate-lanceolate and very peach-like, rather tapering at the base, thick and dull and somewhat pubescent below, coarsely serrate, the stalk with very small glands. Late; blooms very late. One of the best. A wild south Texan variety, introduced by George Onderdonk in 1874.

Honey Drop.—See Missouri Apricot, below.

50. *Indian Chief*.—Large, round, dull red, skin medium thick: flesh firm: cling, the stone very broad and scarcely prolonged into a point, very rough; flowers medium, short-stalked, the calyx lobes glandular; leaves short, broadly elliptic-ovate, comparatively short-pointed, finely serrate, the short stalks glandular. Early. Recalls the Chickasaws. Origin uncertain: said by Munson to have originated in southern Texas, and by Onderdonk

to have come from Georgia; others say that it came from Arkansas. C.

51. *Kanawha*.—Fruit medium to large, round, red, skin medium thick: cling; leaves large and broad with long points, rather thick and dull, the edges irregular with rounded teeth and notches, with several glands on the stalks. Late. Georgia? "Similar to Wayland."—*Munson*. "Almost like Reed. Excellent for spicing. An enormous bearer."—*Berckmans*. C.

52. *Missouri Apricot (Honey Drop)*.—Medium to rather large, round, deep yellow, skin medium: semi-cling, the stone rather short and turgid, produced abruptly into short points; flowers medium, short-stalked; leaves medium in size with conspicuous points and with rather large serrations, light-colored, the whitish stalks bearing very small glands or sometimes even glandless. Late. Perhaps the best yellow plum. Quality high. Found wild in Missouri and introduced by Stark Bros. in 1886. "Every way an improvement on Golden Beauty."—*C. M. Stark*. C.

53. *Moreman*.—Medium in size, round, dark red, skin medium thick: cling, the stone small and nearly circular, the points very short; leaves medium, long-pointed, rather coarsely serrate, rather dull in texture, the stalks nearly or quite glandless. Late. A strong spreading grower, producing abundantly of handsome and high quality fruit. It suggests the Miner group and may belong to it. Originated in Kentucky. Introduced by W. F. Heikes in 1881. "Cooks well. As good as a Damson when spiced."—*Kerr*. C.

54. *Poole (Poole's Pride)*.—Large, round-oblong, red, skin medium thick: cling; leaves rather small and narrow, very finely serrate, the short stalks glandless or nearly so. Early to medium, of high quality. Succeeds Wild Goose. A wild variety from Illinois, introduced in 1888 by Stark Bros. I am not well acquainted with this variety. It looks much like a Chickasaw.

55. *Reed*.—Medium, round, dark red, skin medium: cling, the stone short and turgid, pitted, the point abrupt and short; flowers medium, short-stalked; leaves very broad (elliptic-ovate or even nearly round-ovate) and large, firm, the point abrupt and conspicuous, unevenly serrate, the stalks bearing few small glands. Late. A very strong spreading grower. Much like Moreman in fruit. Said to have been introduced by the late Mr. Reed, Hightstown, N. J. C.

56. *Roulette*.—Medium to rather large, round or round-oblong, red and coloring completely before dropping from the tree, skin thin: cling, stone (like Wild Goose) oblong-obovate and rather

slender, scarcely pointed above ; flowers medium on rather conspicuous stalks ; leaves the shape and size of peach leaves and like those of Wild Goose, the serratures small and even, the stalks glandular. Early to medium. Texan? The Mexican Roulette is evidently the same. C.

57. *Sucker State*.—Large, round, dull red, skin thick : cling ; flowers large, stalked ; leaves medium to large, long taper-pointed, irregularly and obtusely but rather finely (for the size of the leaf) toothed, stalks glandular. Medium to late. Illinois? C.

58. *Texas Bell* (or *Belle*?).—Fruit medium to large, nearly spherical, red : stone short and turgid, obtuse below and very short-pointed above ; leaves medium, elliptic-oblong and short-pointed, finely and evenly serrate, the stalks glandular. Ripens last of June in Texas. Originated by Stephen H. Turner, Texas, and introduced by J. T. Whitaker, Tyler, Texas. Perhaps a Chickasaw.

59. *Wayland*.—Fruit large, round-oblong, shining pink-red, skin medium : semi-cling, the stone rather small for the size of the fruit, turgid and slightly pitted, very short-pointed at both ends ; flowers large and long-stalked, very late ; leaves medium to large, rather thick and heavy, long-pointed, the edges irregularly serrate and notched, the stalks usually glandular. Very late. One of the best native plums, but too late for the northern states. Introduced by Downer & Bro., Fairview, Ky. First propagated in 1876. It came up in a small plum thicket in a corner of the garden of Professor H. B. Wayland, Cadiz, Ky. C.

60. *Whitaker*.—Very large, red ; leaves medium, oblong-ovate, points rather short, very finely and evenly serrate, the stalks with small glands or none. Originated under cultivation in eastern Texas by J. T. Whitaker. Seedling of Wild Goose. C.

61. *Wild Goose* (Fig. 3.)—Large, round-oblong, light red, skin thin : cling, stone long and narrow, prolonged above into a sharp point and below into a narrow base, finely pitted ; flowers medium to large, stalked ; leaves oblong-lanceolate, peach-like, not prominently pointed, the margins finely and evenly serrate, and the stalks usually bearing two to four small glands. Early. Quality poor, but on account of its productiveness, earliness, beauty, good shipping qualities, and its early introduction, it is the most popular of the native plums. The Wild Goose was first brought to notice by James Harvey of Columbia, Tenn. Some time before 1850 a man shot a wild goose near Columbia, and on the spot where the carcass was thrown this plum came up the following spring. It was introduced about 1850 by the late J. S. Downer,



FIG. 3.—Wild Goose. *Sprays half size. Stones full size.*

of Fairview, Ky. This is the first native plum introduced to general cultivation, although the Miner was first known and named. C.

The Wild Goose is either very variable or there are two varieties passing under that name. In the orchards of Mr. Kerr, in Maryland, and Mr. Munson, in Texas, the flowers appear before the leaves in crowded lateral clusters, but in the plantations at the Michigan Agricultural College and at Cornell, they appear with the leaves in diffuse cherry-like clusters, and the pedicels are longer. These latter specimens are so anomalous as to lead good observers to wonder if they are not hybrids with some cherry. I have not been able to observe any constant differences between these two types in foliage or fruit. I am disposed to regard these peculiarities as variations of one variety due to climate or some other local cause, for I find the same differences in other varieties grown here and in the south, as in Newman, Robinson and Marianna (Nos. 83, 86 and 92). I have examined a number of seedlings of Wild Goose at Mr. Kerr's, and while they differ from the parent in flavor and shape of fruit, they are much like it in general texture and character of fruit, the stones are singularly alike and the habits of the trees are similar; but in some of them the leaves tend to be irregularly toothed at the margins after the manner of the Wayland class. It should be said that the tree from which these seedlings were grown stood beside a tree of German Prune, but it is not known if these plants will hybridize.

The range of adaptability of the Wild Goose is great. It is hardy in central New York, and southern Michigan, and it succeeds well in Georgia and Texas. The tree resembles a peach tree.

62. *World Beater*.—Large, round-oblong, dark red, skin medium: cling; leaves medium and long-pointed, rather dull, somewhat irregularly serrate, the stalks usually glandular. Very late. Of good quality. Found wild in Tennessee. Introduced by Stark Bros. in 1889.

The Wild Goose type or group of plums, as a whole, appears to be best suited to the middle latitudes, being grown with satisfaction from Illinois and Indiana, and the southern part of Michi-

gan and New York to Maryland, Virginia and Tennessee, and in the southwest to Texas. The varieties which are most highly prized are Golden Beauty, Indian Chief, Missouri Apricot, Moreman, Wayland and Wild Goose.

C. THE MINER GROUP.—(*Prunus hortulana* var. *Mineri*). This group includes a few anomalous varieties which appear to be intermediate between *Prunus hortulana* and *P. Americana*. They may be an off-shoot of *P. hortulana*, or it is possible that they constitute a distinct species. The Miner is particularly well marked, but there are others which it is somewhat difficult to separate from *P. hortulana*. The group differs from the species by the dull and comparatively thick leaves which are conspicuously veiny below and irregularly coarsely toothed and more or less obovate in outline, by a late very firm fruit and by a more or less smooth and Americana-like stone. Fig. 4 is an excellent illustration of the under surface of a leaf of this group, and Fig. 5 shows the general habit. I am not able to designate the range of the wild plant, but it appears to occur in Illinois (and perhaps Indiana), Missouri, Tennessee, and perhaps in Arkansas.

63. *Clinton* (Fig. 4).—Fruit large, round, dull red, skin medium thick : cling, the stone short and broad and scarcely pointed,

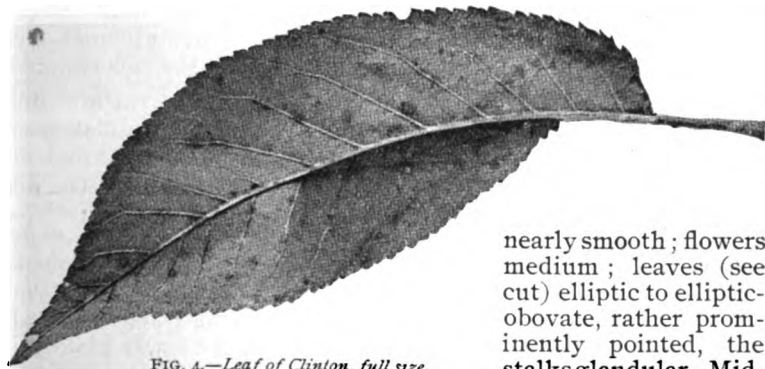


FIG. 4.—Leaf of *Clinton*, full size.

nearly smooth ; flowers medium ; leaves (see cut) elliptic to elliptic-obovate, rather prominently pointed, the stalks glandular. Mid-season, ripening several days before Miner. Thought by some to be the same as Miner, but the leaves, at least, appear to be different.

64. *Forest Rose*.—Large to very large, round, dull red, skin medium thick : stone cling, broad and comparatively flat, sharp on the front edge, scarcely pointed, smooth, Americana-like ;

flowers medium to large ; leaves elliptic to elliptic-obovate, prominently pointed, the stalks ordinarily bearing two small glands. Medium to late, of good quality. A Missouri wild variety, introduced by William Stark in 1878. C.

65. *Idol*.—Medium to rather large, round, bright light crimson splashed with magenta, skin thin : stone small, cling ; leaves obovate, the stalks glandular. Medium season. Said by D. B. Wier, the originator, to be very large, weighing as much as the average Lombard, but B. O. Curtis, Paris, Illinois, who now handles some of Wier's varieties, says that with him it is rather small and ripens the last of September and first of October. Said by Mr. Wier to be a cross between Miner and Wild Goose. Illinois.

66. *Indiana Red*.—Large, round, red : cling ; flowers medium ; leaves elliptic-ovate, prominently pointed, coarsely toothed, the stalks mostly prominently glandular. Medium to late. Said to have been an Indiana wild variety and to have been introduced by Dr. I. Cramer. By some thought to be the same as Miner. C.

67. *Iris*.—A medium red plum, with rather small and turgid stones which are scarcely pointed, and smooth or nearly so ; flowers medium ; leaves elliptic or elliptic-obovate, long-pointed, the stalks glandular. Illinois. D. B. Wier, originator and introducer. C.

68. *Langsdon* (Fig. 5).—Medium, round or round-oblong, light-red : stone cling, small and nearly smooth, turgid, very short-pointed ; leaves obovate or elliptic-obovate, moderately pointed, the glands small. Medium to late. Much like Miner.

69. *Leptune*.—Medium, round, dark-red, skin thick : cling, stone rather small and turgid, nearly smooth, short-pointed ; leaves elliptic ovate to elliptic-obovate, very long-pointed and coarsely serrate, stalks either glandless or glandular. Late. Said to have been introduced by J. D. Morrow & Sons, Arkansas.

70. *Miner*.—Large, round or roundish-oblong, dull red, skin thick : stone cling, short and broad, smooth or very nearly so, very short-pointed, rather sharp on the front edge, Americana-like ; flowers medium to large ; leaves large and heavy, usually inclined to be obovate, rather long-pointed, the stalks glandular. Medium to late. Said by Downing* to have originated with Mr. Miner, Lancaster Co., Penn., but this is a mistake. The seed which produced the Miner plum was planted in 1814, in Knox County, Tennessee, by William Dodd, an officer under General Jackson. Dodd appears to have had two batches of seed, one

* Fruits and Fruit Trees, 2nd ed. 931.

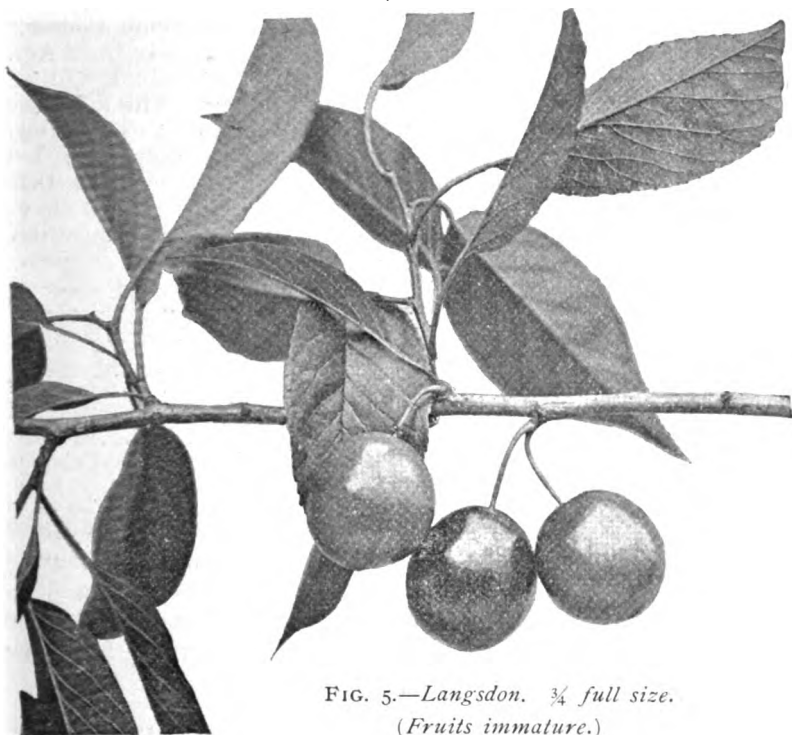


FIG. 5.—*Langsdon*. $\frac{3}{4}$ full size.
(Fruits immature.)

lot this plum sprung. The plum gained some notice when it came into bearing, and was known as Old Hickory and General Jackson. In 1823 or 1824 Dodd moved to Illinois and settled near Springfield, taking some sprouts of his plum with him. The plums soon attracted attention among Dodd's neighbors, and the variety was called in its new home William Dodd and Chickasaw Chief. The year following William Dodd's removal to Illinois, his brother moved to Galena, Illinois, and took some of the plums. About Galena the plum became known as the Hinckley. I do not know how the name Miner came to be applied to it, but Downing's reference to Mr. Miner of Pennsylvania—who probably grew and disseminated it—undoubtedly explains it. It is said by D. B. Wier that the late Hon. James G. Souard, of Galena, gathered the year before upon Talaposa creek, and the other given him by an Indian chief. It is not clear from which

lena, introduced this plum to general cultivation, and I repeated this statement last year in a discussion of the Souldard crab.* (For a fuller history of the Miner, see A. Giddings in Iowa Agr. Rep. 1871, 332.) Downing gives Hinckley, Isabel, Gillett, Townsend and Robinson as synonyms of Miner. The Robinson now known is a very different fruit. (See No. 86.) The Miner is one of the best and most popular of the native plums, and is probably grown farther north with success than any other variety of this species (Groups B and C). In central New York it ripens in October. Colored plate in Agriculture of Pennsylvania, 1881. C.

Parsons.—Supposed to be identical with Miner, which see. C.

71. *Prairie Flower.*—A variety introduced by Stark Bros., Missouri; probably belongs in this group.

72. *Rachel.*—Medium, round-oblong, dull red, thick skin: stone cling, short and broad, thin-margined on the front edge, scarcely pointed, smooth, Americana-like; leaves long, elliptic-obovate, moderately pointed, stalks glandular. Medium to late. C.

The Miner group appears to be a strong and hardy race which is particularly adapted to the northern limits of the cultivation of the Hortulana family. The varieties are much alike. The Miner is the most popular member of the group, and it succeeds even in northern Illinois. In New York the varieties ripen from late September even to late October..

D. THE CHICKASAW GROUP.—(*Prunus angustifolia*, Marshall, *Arbustrum Americanum*, III. [1785]. [*Prunus Chickasa*, Michx. Flor. Bor.-Am. i. 284.]). This group of plums differs from the Wild Goose group (B) by a more slender, spreading and zigzag growth, usually smaller size of tree, red twigs, by smaller, lanceolate or oblong-lanceolate very closely serrate shining leaves which are conduplicate or trough-like in habit, by early small flowers which, upon old wood, are densely clustered on the spurs, and by an early red (rarely yellow) and more or less spotted translucent fruit, the flesh of which is soft, juicy, and more or less stringy and very tightly adherent to the small, broad, roughish stone. It is difficult to separate some of the cultivated forms of this species from small-leaved and weak-growing varieties of

* Amer. Garden, xii. 473.



FIG. 6.—*Newman*. Sprays half size. Leaf and stones full size.

Prunus hortulana, but the two species are easily separated in a wild state. The zigzag young twigs and trough-like leaves of the Chickasaws are characteristic, and are shown in Fig. 6. The leaves are often very small, scarcely exceeding an inch in length, but upon the more vigorous cultivated varieties, as the Newman, the leaf-blades are often three inches long and nearly flat. In herbarium specimens the species is usually recognized by the two halves of the leaves being pressed together so that the upper surface is hidden. In a wild state the trees or bushes are thorny, and the thorns persist in some of the cultivated varieties. It grows wild, often in dense thickets, from southern Delaware to Florida, and westward to Kansas and Texas. It is commonly stated in the books that the Chickasaw plum is not native to the Atlantic states, and some suppose that it was introduced into the United States from countries to the south of us. I have been unable to find sufficient reasons for these opinions, and I believe that the species is native to the southeastern states. In Maryland, as I have seen it, it behaves like an indigenous plant, and the people regard it as a true native. The small acerb fruit of the thorny and scraggly wild bushes is known in Maryland as "Mountain Cherry."

This species, like *Prunus Americana*, was founded by Humphrey Marshall in 1785. His description is as follows: "*Prunus angustifolia*. Chicasaw Plumb. This is scarcely of so large a growth as the former [*P. Americana*], but rising with a stiff, shrubby stalk, dividing into many branches, which are garnished with smooth lance-shaped leaves, much smaller and narrower than the first kind [*P. Americana*]; a little waved on their edges, marked with very fine, slight, coloured serratures, and of an equal, shining green colour, on both sides. The blossoms generally come out very thick, and are succeeded by oval, or often somewhat egg-shaped fruit, with a very thin skin, and soft, sweet pulp. There are varieties of this with yellow and crimson coloured fruit. These being natives of the southern states, are somewhat impatient of much cold."

73. *African*.—Medium to rather large, round-oblong, dark red; leaves small, short-oblong-lanceolate. Early to medium. Orig-

inated under cultivation by G. Onderdonk, S. Texas, and introduced by him in 1870. C.

74. *Arkansas Lombard*.—Medium, round or round-oblong, red; leaves medium, ovate-oblong. Early to medium, ripening just before Newman. Arkansas. Said to have been introduced by J. D. Morrow & Sons.

75. *Caddo Chief*.—Medium or rather small, round, red; leaves medium in size, short, ovate-oblong. Very early, ripening with Early Richmond cherry. Wild from Caddo Parish, Louisiana. Introduced by G. W. Stoner. Blooms and ripens very early. In northern Texas the fruit is ripe the middle of May. C.

76. *Coletta*.—Medium to large, round-oblong, light red; leaves small, oblong-lanceolate. Tree somewhat thorny. Early or very early. Originated under cultivation in southern Texas by G. Onderdonk, who introduced it in 1874. Ripens with Caddo Chief. C.

77. *Early Red*.—Medium, round, red; leaves medium, oblong-lanceolate. Early or very early. Origin southern Texas under cultivation by G. Onderdonk; introduced by him in 1872. There is a Russian plum (*Prunus domestica*), introduced by Professor Budd, known as Early Red. C.

78. *El Paso*.—Medium, round, red; leaves medium, ovate-oblong. Ripens during July and August in southern Texas. Originated and introduced by Lee Beaty, Texas.

79. *Emerson's Early*.—Rather large, round, purple-red, skin very thin: cling. Said to be a good market sort. Very early. Wild variety from northern Texas. Introduced by Mr. Bruce. Similar to Lone Star, but a better grower.

80. *Hoffman*.—Medium to rather large, round, purple-red; leaves medium, oblong-lanceolate. Mid-season to late. A wild variety from southwestern Missouri. "Very sure and prolific [in Texas]."—*Munson*. Ripe in northern Texas the middle of July, later than the Wild Goose.

81. *Jennie Lucas*.—Medium to rather large, round, yellow; leaves short, ovate-oblong. Early. Originated under cultivation and introduced, in 1875, by G. Onderdonk, southern Texas. C.

82. *Lone Star*.—Rather large, round-oblong, red, skin very thin; leaves rather small, oblong-lanceolate. Early. Originated in Texas by E. W. Kirkpatrick; grown from wild seed from eastern Texas. C.

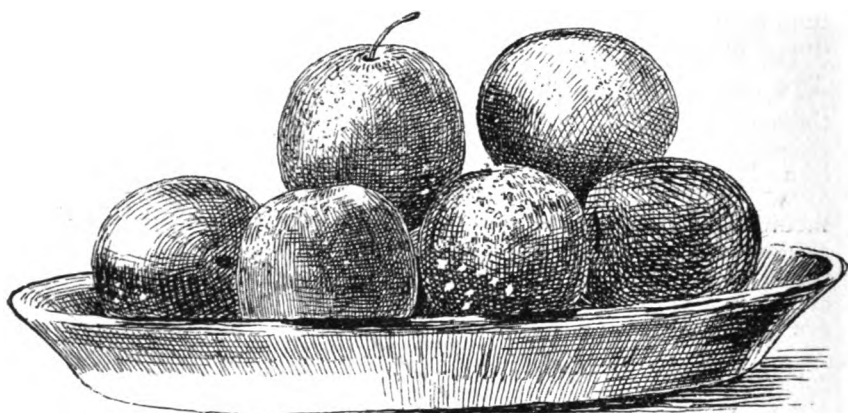


FIG. 7.—*Newman Plums. Natural size.*

83. *Newman* (Figs. 6 and 7).—Rather large, nearly globular or round-oblong, pink-red with prominent light spots near the apex, yellowish opposite the sun; leaves rather large, oblong-lanceolate. Medium to late. Ripens in New York in October. Introduced from Kentucky by W. F. Heikes. One of the best known of the Chickasaws. In our plantation the Newman is hardy, but the flowers, instead of appearing before the leaves as in the central and southern states, appear with the leaves in loose umbel-like clusters. This is the same kind of variation which occurs in the Wild Goose (see No. 61). In some of the New York trees the leaves are unusually large and often nearly plane. The Chickasaw method of growth is fairly well retained, however. Warren is thought to be identical with Newman. C.

84. *Ogeechee*.—Small to medium, round-oblong, red; leaves short, ovate-oblong. Very early. Similar to Caddo Chief. Wild from Georgia; introduced by G. Bourquin.

85. *Pottawattamie*.—Rather large, round, red; leaves rather small, narrowly oblong-lanceolate to ovate-oblong. Early to medium. Tennessee; it was taken to Iowa in a lot of Miners, and came under the notice of J. B. Rice, Council Bluffs, in 1875, who introduced it. Various stories are told about its origin, but the above is correct. It appears to have received its name from Mr. Rice. Like the Newman, the leaves appear to be larger in the north. "Enormous bearer."—*Berckmans*. C.

86. *Robinson*.—Medium, round, blotched red; leaves medium or small, ovate-oblong or oblong-lanceolate. Mid-season. "This is a seedling grown by a Mr. Pickett, of Putnam county, Indiana,

from a seedling brought with him from North Carolina, nearly fifty years ago, and has, almost every season (since large enough) borne abundant crops, but was neglected, and never brought to the notice of the public till 1879, when Dr. J. H. Robinson (of the same township) read a paper before the Indiana Horticultural Society, on Chickasaw Plums, and gave a very flattering description of this plum, which he had been watching since 1872, and of which he had two good crops on his own trees, which bore two bushels to the tree five years after planting, and has borne good crops annually, except once, when killed by late frosts. It was named by the Putnam County Horticultural Society in honor of Dr. Robinson."—Albertson & Hobbs, Bridgeport, Indiana (1885), who introduced the variety in the fall of 1884 and spring of 1885. Like Wild Goose and Newman, in New York the flowers appear with the leaves. C.

87. *Schley (Schley's Large Red)*.—Rather large, round, red; leaves medium, ovate or lance-ovate. Early to medium. Said to have been introduced from Georgia by W. K. Nelson. Much like Roulette except in foliage. Possibly *Prunus hortulana*. A very spreading and straggling grower. C.

88. *Strawberry*.—We are growing but have not fruited a plum under this name which appears to have been recently introduced. I know nothing of its history. C.

Warren.—See Newman.

89. *Woolen*.—Large, round-oblong, yellow with red markings; leaves medium, oblong-lanceolate. Medium to late. Found wild in central Texas (Colorado River), and introduced by A. M. Ramsey. "Very sure and prolific."—*Munson*. Ripe from early to middle July in northern Texas. Possibly *P. hortulana*.

90. *Yellow Transparent*.—Rather large, oblong, lemon yellow; leaves rather small, oblong-lanceolate. Early. Originated in northern Texas by J. L. Freeman. Selected from thousands of varieties grown from wild seed.

I have plants from Kansas under the name of "Kansas Dwarf Cherry," which are evidently a bush-like form of this species. They have not yet borne.

The "Sand Plum," which is occasionally grown in Nebraska, is *Prunus angustifolia*, if I may judge from leaves sent me by Dr. C. E. Bessey, of the University of Nebraska. Dr. Bessey writes as follows of this plum: * "Occasionally I hear of a 'Sand Plum,' said to grow in the southwestern and western parts of the state. No authentic specimens have been seen although I have in my

* Second Report upon Native Trees and Shrubs of Nebraska, 18.

collection some twigs and leaves from plants cultivated under this name, and thought, by the growers, to have been taken up from wild patches in the state." It is not improbable that this Sand Plum is the same as the Kansas Dwarf Cherry mentioned above.

The Chickasaw group is particularly adapted to the southern states and it succeeds as far north as Maryland and Kentucky, while some of the varieties are hardy in central New York. The leading varieties are Caddo Chief, Jennie Lucas, Lone Star, Newman, Pottawattamie, Robinson and Yellow Transparent.

E. THE MARIANNA GROUP.—The Marianna and De Caradeuc plums—and probably, also, the Hattie—constitute a distinct class from any of the foregoing, differing in habit of tree, very early flowering, elliptic-ovate rather small and finely serrate dull leaves, glandless leaf-stalks, and soft spherical, very juicy plums of a "sugar and water" character, and broad ovate stones which are scarcely pointed and are prominently furrowed on the front edge. The botanical position of these plums has been a subject of speculation, to which I have added my full share of confusion.* I have devoted more study to these plums than to any others, and I am now convinced that the De Caradeuc is myrobalan and that the Marianna is either the same species or a hybrid between it and some American plum, possibly the Wild Goose. This, I am aware, is a startling conclusion, particularly as the Marianna has come to be so extensively used as a stock to replace the myrobalan, which appears to be growing in disfavor. Before entering into detail concerning the origins of these plums, it will be useful to our inquiry to clear up some of the history of the myrobalan plum.

The word myrobalan (or myrobolan), as a noun, is used to designate various small tropical fruits which are used in the arts, chiefly for tanning purposes. It is now commonly applied to the fruits of the species of *Terminalia*, of the family *Combretaceæ*, which are imported from India. The word was early applied to a small plum grown in Europe, probably because of some resemblance in size or other characteristics to the myrobalans of commerce. This plum has had a curious history. The first un-

* In my Nursery-Book (p. 252) I referred them to *Prunus umbellata*, Ell.

doubted reference to it which I know is in Clusius' *Rariorum Plantarum Historia*, 1601. Clusius gives a good figure of it, but says that it was not generally known. Some people thought that it came originally from Constantinople, and others that it came from Gaul. Clusius leans toward the latter view. He calls it the myrobalan plum, but does not know the origin of the name. For nearly two hundred years after Clusius wrote, the fruit is described by various authors in different parts of Europe, under the names of myrobalan or cherry plum, during which time doubts were cast upon its European origin. Thus Tournefort in 1700 said that it came from North America. In 1789 Ehrhart* described it as a distinct species under the name *Prunus cerasifera* or "cherry-bearing plum," and said distinctly that it is a native of North America. Some thirty years before this time, Linnæus had described it as *Prunus domestica* var. *myrobalan* and gave it a European origin. In 1812, Loiseleur Deslonchamps† described it as *Prunus myrobalana*, saying that it was supposed to be of American origin. From that time until now the nativity of the myrobalan plum has been uncertain, but European writers have usually avoided the difficulty by referring it to America; and American botanists have for the most part ignored it because it is a cultivated plant. So it happens that this pretty fruit has fallen between two countries, and is homeless. Sereno Watson in his Index to North American botany published in 1878, refers Ehrhart's *Prunus cerasifera* to the common beach plum (*Prunus maritima*) of the Atlantic coast. But the myrobalan is wholly different in every character from the beach plum, and it has been long cultivated upon walls in Europe, a treatment which no one would be likely to give to the little beach plum. Torrey and Gray in 1838, in the Flora of North America, do not mention the myrobalan plum. After all the exploration of the North American flora, no plant has been found which could have been the original of this plum; while its early cultivation in Europe, together with the testimony of Clusius and other early herbalists, is strong presumption that it is native to the Old World. This presumption

*Beiträge zur Naturkunde, iv. 17.

†Nouveau Duhamel Traité des Arbres et Arbustes, v. 184, t. 57, fig. 1.

is increased by the doubt which exists in the minds of the leading botanists, from Linnæus down, as to its systematic position, for if there is difficulty in separating it from *Prunus domestica*, the original of the common plum and which is itself a native of the Old World and immensely variable, there is strong reason for suspecting that it is only an offshoot of that species; and this presumption finds strong support in other directions. But one need not study far into the European plums until he convinces himself that the essential features of the myrobalan plum are present in several of the wild or half wild forms of southern and southeastern Europe, no matter what the ultimate origin of the fruit may be. Plums from Turkestan (presumably wild) now growing upon the grounds of Ellwanger & Barry at Rochester, N. Y., are certainly myrobalan; and it may be said that the so-called *Prunus Pissardi*, which has been recently introduced from Persia, is but a purple-leaved myrobalan plum.* I have no doubt, therefore, but that the myrobalan plum is native to Europe or Asia; and it is full time that an America origin be no longer ascribed to it.†

The myrobalan plum has long been used in this country as a stock for various plums. Except upon the Pacific coast, it appears to be falling into disuse, however, as it dwarfs the cion and is not suited to all varieties. The endeavor to find some stock which can take the place of the myrobalan has resulted in the popularizing of the Marianna, but which, if not pure myrobalan, certainly partakes very largely of it. The myrobalan is generally distributed over the country as a stock, and bearing trees of it are occasionally seen. The Golden Cherry plum of Downing‡ is undoubtedly this species, and the fruit now known as Youngken's Golden Cherry is certainly myrobalan, and it is probably identical with the variety described by Downing. The fruits may be either yellow or red in various shades. They are round and cherry-like, with a depression at the base, on slender stems, ranging in size from that of a large cherry to an inch and a half in diameter. The myrobalan is very variable, a fact which finds

*Mr. Kerr has grown a purple-leaved plum from seed of De Caradeuc.

†See also Garden and Forest, i. 178.

‡Fruits and Fruit Trees, 916.



FIG. 8.—*Marianna*. Sprays half size. Details full size.

record in the various shapes and sizes of the commercial imported stones.

91.—*De Caradeuc*.—Rather large (1 to $1\frac{1}{4}$ in diam.), globular, deep dull purple red when ripe with a prominently colored suture, but yellowish green splashed with red when it first becomes edible: flesh thin, very juicy and sweet: cling, the stone round-ovate, rather turgid, scarcely pointed and evenly pitted; leaves rather firm, ovate-oblong. Early. In central New York it ripens from the first to the middle of August. Tree an erect grower. This plum appears to agree with the myrobalan in all important botanical characters, even to the broad and strongly reflexed calyx lobes and stalked flowers. About a year ago I became convinced that De Caradeuc is *Prunus cerasifera*, and I was glad to have my opinion confirmed by so good a nurseryman as P. J. Berckmans of Georgia, who named the variety; and the origin of the plum, which I have since learned, corroborates my conclusion. It originated with A. De Caradeuc upon his former farm near Aiken, South Carolina, about the years 1850 to 1854. Mr. DeCaradeuc imported some French plums, from the seed of which this variety came. There were several Chickasaw plums in the vicinity of the French trees and Mr. DeCaradeuc thinks that the variety under consideration is a hybrid, but I am unable to discover any evidence of hybridity. The original tree of the variety "outgrew the parent, and reached a diameter of head of fifteen feet, was entirely free from thorns and suckers, and bore a remarkably rich and beautiful foliage." The variety blooms very early, some days ahead of the Marianna, and the flowers, as in all varieties of *P. cerasifera*, are somewhat scattered and less abundant than in the native species. C.

92. *Marianna*. (Fig. 8).—Large, round-oblong, short stemmed as compared with the De Caradeuc, bright red and finely speckled and covered with a thin bloom: flesh soft and sweet, juicy: semi-cling, the stone like that of DeCaradeuc (see Fig. 8); flowers small, sessile or short-stalked, in dense lateral clusters like the native varieties, the calyx lobes, narrow and erect; leaves much as in De Caradeuc, but thinner. A little later than De Caradeuc, but ripens before the Wild Goose. Tree a very spreading grower. C.

From the above description it will be seen that the Marianna is in several respects intermediate between *Prunus cerasifera* as represented in DeCaradeuc, and the native American plums, particularly in the short-stemmed fruit, small nearly sessile and clustered later flowers and erect narrow calyx lobes, and spreading habit. It is therefore little surprise to learn that the originator considers it a seedling of Wild Goose. It originated as a seedling in a

mixed orchard at Marianna, Polk Co., Texas, the property of Charles G. Fitzè. So far as I can learn, the seed was not hand-sown, and there is a chance for error in the history. The variety was introduced in 1884 by Charles N. Eley, Smith Point, Texas.

The Marianna grows readily from cuttings, and this, in connection with the hardiness and vigor of the variety and the readiness with which it unites in graftage with several species of prunus, has made it very popular as a stock. The myrobalan itself grows from cuttings but in most cases not to a profitable extent. I have recently made a small experiment upon the rooting of cuttings of myrobalan, De Caradeuc and Marianna in identical conditions, under heat. Of myrobalan cuttings, less than ten per cent. grew; of De Caradeuc, less than twenty per cent.; of Marianna, about seventy per cent. I do not know where the Marianna could have obtained this peculiarity to grow readily from cuttings; but it is idle to attribute it to hybridity until we have determined if all varieties of myrobalans grow with equal difficulty from cuttings. The question will at once arise if the Marianna is reliable as a stock, seeing that it is probably partly of myrobalan origin; and in reply I can only say that experience alone can determine the value of a stock. Thus far the Marianna has given good results. I apprehend that some of the dissatisfaction with myrobalan stocks should be laid to the indiscriminate use of variable seedlings; in order to obtain uniform results a particular variety or strain of myrobalan should be used. In this connection I may observe that the flowers of Marianna appear with the leaves in New York, while they appear before the leaves—as shown in Fig. 8—in the middle and southern states; and this peculiarity I have observed in myrobalan, and also, as previously recorded, in Wild Goose, Newman and Robinson.

93. *Hattie*.—Medium, round-oblong, red: cling, the stone much like that of Marianna in shape but rather more pointed and nearly smooth; flowers small and clustered, the calyx lobes small and erect; leaves small, short-oblong or ovate-oblong, somewhat conduplicate, dull and firm, finely serrate, the stalks glandless; branches stiff and conspicuously rough or warty. Early, below medium in quality. The history of this plum I am unable to trace. In some respects it closely resembles the Chickasaws, but I cannot escape the conviction that it is partly myrobalan. I have seen the same rough shoots in the myrobalan plum. C.

F. THE BEACH PLUM.—(*Prunus maritima*, Wangenheim [1781]). Fig. 9. The beach plum is a straggling more or less decumbent bush, reaching three to six or even twelve feet in height, growing in the sands of the sea-coast from New Brunswick to Virginia, and perhaps extending farther towards the southwest.* The flowers are rather large for the size of the plant, and are borne on prominent stalks in clusters. The fruit, in the best forms, is about a half inch in diameter (see Fig. 9), and is deep, dull purple when ripe, and covered with a dense bloom; the flesh is brittle, sweet and juicy, entirely free from the stone; the skin is thick and tough, and usually leaves an acrid taste in the mouth when the fruit is eaten. Upon the Jersey coast the fruit is ripe the middle of August. *Prunus maritima* is in cultivation as an ornamental plant, it being very showy when in bloom and interesting in fruit. It succeeds well under cultivation in the interior states. As a fruit plant it has given rise to but one variety:

94. *Bassett's American* (Fig. 10).—Small (about $\frac{3}{4}$ in. in diameter), round or slightly round oblate, dull red, skin medium thick: free-stone, the stone nearly circular in outline with a very short point or even pointless, thin upon the front edge, slightly rough; leaves a fourth or third larger than those of the wild beach plum. Medium to late, ripening in late August in eastern Maryland. Quality poor. Introduced about 20 years ago by Wm. F. Bassett, Hammonton, N. J., who bought the original tree of a man who found it in the neighborhood. It works well upon the Wild Goose, and Mr. Bassett writes me that he has a tree on such roots which is fifteen feet high. It was largely brought to notice through the efforts of the Rumson nurseries, where it was worked upon the myrobalan plum and the peach. I have seen a vigorous large tree at Mr. Kerr's grafted upon the Richland, which is *Prunus domestica*. Mr. Kerr also finds that it grows upon the Chickasaws. The variety appears to differ from the wild beach plum only in size.

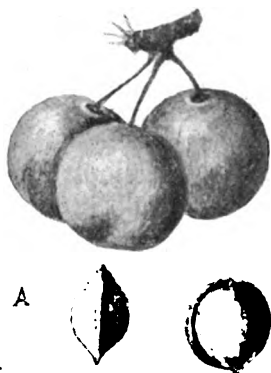


FIG. 10. - *Bassett's American*.
Full size.

G. PRUNUS SUBCORDATA, the wild plum of the Pacific coast,

* *Prunus maritima* has been found recently near the head of Lake Michigan. It is supposed to have been introduced.



FIG. 9.—*Beach Plum* (*Prunus maritima*). Sprays half size. Details full size.

was introduced to cultivation in 1889 by T. V. Munson (see *Annals Hort.* 1889, 104 ; 1891, 235). It is a straggling much branched shrub growing from three to ten feet high. It has subcordate roundish or round-ovate tomentose leaves and large pedicelled flowers which appear with the leaves. The red fruit reaches three-fourths inch long. It is eaten by Indians and whites. Its value in cultivation is yet to be determined.

2. H. HYBRIDS.—It is not known to what extent the native species of plums hybridize with each other or with foreign species, and nearly all the definite attempts at crossing are so recent that results have not been obtained. The only apparently authentic hybrids have come from the union of the Wild Goose and the peach. Mr. Kerr has what appears to be an undoubted hybrid. The tree, as I recall it, is large, spreading and peach-like. The leaves are long and peach-like, although rather broad and short-pointed, but the flower buds, although they form in profusion, never open, so that the tree is barren. This is a hybrid between the Wild Goose and Troth's Early peach. Twenty-five flowers of Wild Goose were emasculated in the bud and covered with paper sacks. When in full bloom, peach pollen was applied, but the flowers were not again covered. Twenty-one of the flowers set fruit, and twenty-one trees were obtained from the seeds. Twenty of the trees were indistinguishable from peach, but the remaining one, as indicated above, gives every evidence of being a hybrid. One other apparent hybrid is the

95. *Blackman*.—Nearly thirty years ago Mrs. Charity Clark procured from an orchard in Rutherford Co., Tenn., which contained Wild Goose and Washington plums, seeds of plums and gave them to Dr. Blackman, of Nashville. One tree among the resulting seedlings bore good fruit and it was called the Blackman, and was disseminated by a local nurseryman. A competing nursery, in endeavoring to procure cions from this tree, inadvertently cut them from an adjacent tree—itsself one of the batch of seedlings—and sold the trees which it grew as Blackman. Now this second tree makes fruit buds in abundance but they never open ; and from the resemblance of the leaves to those of the peach the plant is generally thought to be a hybrid between the Wild Goose and the peach. This assumption finds partial confirmation in the experiments of Mr. Kerr, recorded above, for this spurious Blackman is very much like his hybrid although the leaves are more pointed and still more peach-like. Curiously enough, the genuine Blackman has never been widely dissem-

ainted, but the spurious and worthless substitute has been sold in large quantities. In order to avoid confusion, the original Blackman has been rechristened Charity Clark. There are therefore, two Blackman plums, one of which is practically unknown to cultivation, but which has been renamed, and the other is barren and will soon pass from sight.* C.

I. UNCLASSIFIED VARIETIES.—The following varieties I know only from printed references or from information afforded by correspondents, and I cannot, therefore, refer them to their proper species.

96. *Allen's Yellow*.—Medium, round, yellow and red, skin thick : cling. Kansas.

97. *Berry*.

98. *Champion*.—Very large, oblong, dark red, thick skin : flesh firm : cling. Late. H. A. Terry, 1890. Originated under cultivation.

99. *Charles Downing*.—Large, round-oblong, red, skin thin : flesh firm : cling. Medium to late. Should be worked on peach. H. A. Terry, Iowa, 1885. Originated under cultivation.

100. *Cherokee*.—A medium size plum, round-oblong, blotched red, thick skin : cling. Said to have been found wild in Kansas.

101. *Col. Wilder*.—Large round-oblong, red, thin skin : flesh firm and of best quality : cling. Medium to late. H. A. Terry, Iowa, 1888. Originated under cultivation.

102. *Cook's Choice*. Medium, round, red, thin skin : flesh of best culinary quality : cling. Medium to late. H. A. Terry, 1885. Originated under cultivation.

103. *Couler*.—From Wm. Couler, Chickasaw Co., Iowa. "The Couler is a large plum of fair quality, ripening a little before Miner, but sometimes cracks open badly before ripe."—O. H. Kenyon McGregor, *Iowa Hort. Rept.* xvii. 235.

104. *Crescent City*.—Rather large, oblong, dark red, skin thick : cling. Late. H. A. Terry, Iowa, 1885. Originated under cultivation.

105. *Diamond*.—Seedling from wild Nebraska seed grown by John A. Hogg. "Grows fully as large as most of the tame varieties. Ripens last of September, and when fully ripe gets bright red on one side."—John A. Hogg, *Nebr. Hort. Rept.* 1890, 121.

106. *Dr. Dennis*.—Large, round-oblong, red, thin skin : flesh

*For a fuller account of the Blackman plums, see VanDeman in Rept. Dept. Agric. 1887, 636. The Blackman has been recommended as a stock for peaches upon the supposition that it enjoys immunity from yellows. See Cal. Orchard and Farm, iv. 3.

firm and good : cling. H. A. Terry, Iowa, 1890. Originated under cultivation.

107. *Dunlap*.—Large, round, yellow, thin skin : flesh firm and of high quality : cling. Medium season. Nebraska seedling introduced by J. P. Dunlap.

108. *Early Honey*.—An early variety, evidently a Chickasaw, which originated in Grayson Co., Texas.

109. *Ellis*.—Rather large, round, red, skin very thin : semi-cling. Ranks high for market or for home use. Late. Said to be a cross between Wild Goose and Golden Beauty. N. Texas. Introduced by T. L. Ellis.

110. *Esther*. Rather large, round-oblong, dark red, skin thick : cling. Medium to late. H. A. Terry, Iowa, 1885. Originated under cultivation.

111. *Excelsior*.

112. *Hammer*.—Large, oblong, light red, skin thin : of extra quality : cling. Medium to late. H. A. Terry, Iowa, 1888. Originated under cultivation. Said to be a seedling of Wild Goose.

113. *Houston County*.

114. *Hughes*. A large round red plum said to have come from northern Mississippi.

115. *Iola*.—Very large, oblong, dark yellow and red, skin medium thick : flesh firm : free. Late. D. B. Wier, Illinois.

116. *Irene*.—Very large, round, bright red, thick skin : flesh firm : cling. Late. D. B. Wier, Illinois.

117. *Ithaca*.—Said to have come from Peter M. Gideon, Minn.

118. *James Vick*.

119. *Jewell*.

120. *Jones*.—Large, oblong, red, skin thick : flesh firm, good : cling. Late. H. Jones, Iowa, 1882. Originated under cultivation.

121. *Miles*.—Said to have originated in Illinois from seed taken from North Carolina.

122. *Milton*.—Rather large, round-oblong, dark red, skin thin : flesh firm : cling. Early. H. A. Terry, 1885. Said to be a seedling of Wild Goose.

123. *Mrs. Clifford*.—Very large, pear-shaped, red, skin very thin : semi-cling. Fine for market or home use. Possesses a peculiar and agreeable pineapple flavor. Medium early. Originated in northern Texas under cultivation, and introduced by E. C. Clifford. Said to be a seedling of Wild Goose, and a great improvement upon that variety.

124. *Muncy*.
125. *Munson*.—Rather large, oblong, red, skin thin : cling. Late. Originated under cultivation in Texas. Introduced in 1888 by G. Onderdonk.
126. *New American*.
127. *Okaw*. (Annals Hort. 1890, 175).
128. *Piram*.—Large, round, yellow, skin thin : cling. Medium early. A very productive variety. Originated under cultivation in Texas and introduced by G. Onderdonk.
129. *Rare Ripe*.—A dark red plum a little smaller than De Soto : cling. Quality better than De Soto, but inferior to Harrison's Peach. Hardy.—C. A. Keffer, Bull. 26, S. Dak. Exp. Sta.
130. *Raymond*.
131. *Rockford*.—Good size, round, purple, thin skin : of best quality : cling. Medium to late. Wild Iowa variety, introduced by C. G. Patten, Charles City Iowa, 1889. C.
132. *Rocky Mountain Seedling*.
133. *Round*.—From Iowa.
134. *Silas Wilson*.—Large, round-oblong, light red, skin thin : of best quality : cling. Medium to late. H. A. Terry, Iowa, 1890. Originated under cultivation.
135. *Smiley*.—Very large, dark red. Alabama?
136. *Tenneha*.
137. *Tomlinson*.
138. *Van Deman*.—Large, round, light red, skin thin : of best quality : cling. Medium to late. H. A. Terry, Iowa, 1890. Originated under cultivation.
139. *Wady's Early*.—Early and very good, but the tree is a poor grower and the fruit is rather small.
140. *Winnebago*.—Fruit above medium in size, orange-scarlet, excellent for culinary purposes. Minnesota. Probably *P. Americana*.

§ 2. Cultivation of the Native Plums.

1. *Impotent varieties. Planting*.—It is not strange that difficulties should beset the cultivation of fruits which are yet scarcely rescued from a wild state. The chief difficulty in the growing of the native plums is the fact that some varieties do not fertilize themselves. This peculiarity appears to be due not to any imperfection in the flowers but to the comparative impotency of pollen upon flowers of the same variety. Imperfect flowers are occasionally observed, but they are apparently peculiarities of individual trees or particular seasons. Thus in our Newmans

this year only about every twelfth flower has a perfect pistil. I have observed a similar defect in wild plums. I know a wild tree of *Prunus Americana* which bears flowers without pistils. The impotency of pollen appears to be characteristic of certain varieties, as, for example, Wild Goose, Miner, Wazata, Minnetonka, Itaska. Other varieties of the same species are fertile with themselves, as Moreman, Newman, Wayland, Golden Beauty, Marianna, Deep Creek, Purple Yosemite. In order to insure fertilization, mixed planting is practiced when the impotent varieties are grown; and it is an important study to determine what varieties are the best pollinizers for a given kind. Evidently, the two varieties in any case must bloom at the same time and the pollinizer must produce an abundance of pollen. Thus the Newman is a good pollinizer for the Wild Goose, but it blooms too early for the Americana varieties. In some of the western states, Forest Garden is considered to be a good pollinizer for Miner. It is a common opinion among good plum growers that the common or *Domestica* plums, the peach and even the cherries will fertilize the Wild Goose. There is certainly much general evidence in support of this opinion, but it remains to be proved. A case within my own experience lends color to this opinion. A half dozen large trees of Wild Goose were barren until trees of plums and cherries about them bloomed profusely, when the Wild Goose bore a heavy crop.

There is much difference of opinion concerning the methods of planting in order to secure fertilization. Many growers advise planting in thick hedge-like rows, the trees standing not more than four or eight feet apart in the row, every fourth or fifth tree, or every alternate row, being a self-fertile and very polliniferous variety. Others practice setting the trees from nine to twelve feet apart each way, with the impotent varieties in alternate rows. In this way, for example, Forest Garden is made to fertilize both Miner and Wild Goose. This treatment is commonly known as "close planting," and it has many able advocates. It is said, also, that this close planting shades the ground so completely as to make it too cool for the rapid development of the curculio. Such plantings, unless the trees are heroically trimmed, soon result in an unmanageable tangle. I have seen a Wild Goose tree 36 feet across and still growing and bearing, and Miner, Leptune and

sdon scarcely less. Mr. Kerr, who is a very successful
er, sets his trees from twenty to thirty feet apart, and others
good success with equally thin planting. It is probable
different varieties or combinations demand different treat-
t in this respect ; but it is plain that while the majority of
e plums appear to be self-fertile, some of the most important
ties are impotent.

Propagation.—Another important difficulty is that relating
e selection of stocks. The native species work well upon
other, but the permanency and strength of the different
us are still moot points. The varieties also unite readily with
Marianna ; and Domestica plum stocks, myrobalan and peach
also used. In general, it may be said that a variety prefers a
k of its own species, although the true Chickasaws sprout or
er so badly as to make them undesirable. In the northern
s, especially in the prairie region, the *Prunus Americana*
ts are most reliable because of their hardiness ; and as the
ricana varieties are the ones chiefly grown in this region, the
tem is a comparatively simple one. Wild Goose is grown
ly upon the peach in the warmer latitudes and some growers
r this stock even in the north. All the Chickasaws grow
upon the peach, as do also Miner, Forest Rose, and per-
all the Hortulana type. Recently the Marianna has come to
popular stock upon which to work all varieties ; and as far
nown it is one of the best, although I fear that its indiscrimi-
use may result in some disappointment. Mr. G. Onderdonk,
ll known nurseryman and fruit grower of Texas, is certain
the Marianna is preferable to the peach as a stock for the
ern native plums. His reasons for this opinion are as
ws :*

1st. The peach sometimes sprouts from the roots. The
anna never does this.

2d. The peach has more eyes or buds near the surface of the
both above and below, than the Marianna. These eyes cause
ast two or three times more pruning in the case of peach
s than in Marianna.

3d. The peach requires better drainage than the plum stock.

Fruit Growers' Journal.

I raise good healthy plum trees on Marianna stocks in places where it would be useless to plant anything on peach stocks.

"4th. The peach stock is subject, under certain conditions, to root-rot. I have never seen a case of root-rot among Mariannas.

"5th. While the Marianna is subject to root-knot as well as the peach, yet it very seldom fails to have the knot at the bottom, so that it can be cut away without injury to tree. In case of peach stocks the tree is usually lost when infested with root-knot.

"6th. In extreme southern Texas peach seeds fail to germinate either totally or partially after a mild winter. In the spring of 1890, not a single peach seed germinated in this section. We have much annoyance from this source. On the contrary we have never failed of securing a good stand of Marianna plants from cuttings, when they had been properly treated. Therefore the Marianna makes us a sure supply of stocks for propagation of plum trees, which the peach does not do in southern Texas. Farther north these conditions may be less worthy of consideration.

"7th. As each peach seedling is a distinct variety from every other one, and the different varieties vary materially in vigor, and often in other habits, it follows that the stocks necessarily vary in capacity to develop trees. On the other hand a reasonable amount of care in selecting cuttings of the Marianna enables us to produce stocks of nearly uniform capacity, and therefore to produce trees of a more nearly uniform strength and value."

These comparisons will hold, Mr. Onderdonk thinks, in reference to stocks for apricots, but for peaches the Marianna is a failure with him.

Sprouts from own-rooted trees are often employed for increasing native plums, of such varieties as sprout readily, as Miner, Wild Goose, Forest Garden, De Soto and various Chickasaws. But this practice is not in general favor.

3. *Varieties.*—The question of the best varieties for certain purposes and regions is a disputed one, as should be expected from the large number of varieties in cultivation and the newness of the native plum industry. Undoubtedly the most popular variety is the Wild Goose, but its popularity is due less to the quality of its fruits than to the hardiness and productiveness of the tree and the early fruit. The Miner is perhaps the hardiest

known variety of the Hortulana type. It succeeds in many parts in northern Illinois. In Wisconsin, Iowa, Nebraska, and southward to the north of them, only the Americana class is hardy, as a rule. The Chickasaws are best adapted to the middle and southern states. None of the native plums have been tried to any extent in New York and New England, from the fact that the European or Domestica plums succeed so well there. The incurvation of the septoria or shot-hole fungus,—which causes premature dropping of the leaves,—are calling attention to the native varieties, and it is not too much to expect that they will gain in popularity as they become better known. And the growing taste for a greater variety of fruits must tend to popularize some of the native plums in the east.

In order to determine the values of the leading varieties in different parts of the country, I have obtained the opinions of various representative growers, and these estimates are related below. Two estimates have been asked for each variety, one upon its market value as judged by productiveness, vigor of tree and size, beauty and firmness of fruit, and one upon its home value as a culinary or dessert fruit. The estimates are expressed in figures, 10 being taken to represent the highest excellence. The figures in the first double column were compiled by myself and were sent to all the correspondents, who checked their disagreements from my estimate. In general, therefore, it may be said that when a correspondent gives no estimate, he agrees with my own; although there are some varieties in each column with which the correspondent was not acquainted, and he should not be held to a strict account for the unreported varieties. Finally, I wish to say that my own estimates are made very largely upon the judgments of Mr. Kerr, of the Chesapeake Peninsula (Maryland), and that all my figures will apply to that region.

TABLE I.—HOME AND MARKET VALUES OF NATIVE PLUMS.

No. in preced- ing lists.	Variety.	Species.	Kerr, Md. S. Gordon, N. J.		Onder- donk, Tex.		Stark, Mo.		Carpenter, Neb.		Terry, Ia.		Wier, Ill.		Lord, Minn.	
			Home.	Market.	Home.	Market.	Home.	Market.	Home.	Market.	Home.	Market.	Home.	Market.	Home.	Market.
73	African.....	angustifolia.....	5	8	8	8										
74	Ark'nsas Lombard.....	angustifolia.....	5	5												
75	Caddo Chief.....	angustifolia.....	4	5			1	0							10	10
5	Cheney.....	Americana.....	8	10												
63	Clinton.....	hortulana var.....	7	8												
76	Coletta.....	angustifolia.....	5	7												
47	Cumberland.....	hortulana.....	5	7	6	8										
91	De Caradenc.....	cerasifera?.....	7	10	8	10										
8	Deep Creek.....	Americana.....	8	7												
9	De Soto.....	Americana.....	8	10	5	8	10		9						10	10
77	Early Red.....	angustifolia.....	4	5	3	3	1	0							5	5
10	Forest Garden.....	Americana.....	7	8	6	7	1	5	8	9	10					
64	Forest Rose.....	hortulana var.....	7	8	10	8	10	10								
48	Garfield.....	hortulana.....	9	—												
49	Golden Beauty.....	hortulana.....	10	8	5	7	5								5	5
12	Harrison's Peach.....	Americana.....	9	8	10	10									8	10
93	Hattie.....	?.....	4	6	5	6										
13	Hawkeye.....	Americana.....	8	10			5		7	9						
66	Indiana Red.....	hortulana var.....	8	7												
50	Indian Chief.....	hortulana.....	5	10												
17	Itaska.....	Americana.....	7	7												
81	Jennie Lucas.....	angustifolia.....	5	6			1	0								
18	Kickapoo.....	Americana.....	5	8	8	8										

[illegible]

TABLE II. SUCCESSION OF PLUMS ON THE CHESAPEAKE PENINSULA. (KERR).

Very Early.	Early.	Medium Early.	Medium.	Medium Late.	Late.
Caddo Chief (75) Early Red (77) De Caradeuc (91)	Marianna (92) Yellow Transparent (90) Jennie Lucas (81) Hattie (93) Lone Star (82)	Newman (83) (<i>Warren</i>)	Schley (87) Indian Chief (50) Wild Goose (61)	Roulette (56) Robinson (86) Cumberland (47) Ark. Lombard (74) Wazata (38) Itaska (17) Minnetonka (27) Deep Creek (8) Pottawattamie (85)	Wayland (59) Moreman (53) Wolf (42) Rollingstone (35) Kickapoo (18) Missouri Apricot (52) Purple Yosemitte (33) Miner (70) Clinton (63) Leptune (69) Reed (55) Quaker (34) De Soto (9) Forest Rose (64) Forest Garden (10) Golden Beauty (49) Indiana Red (66) Louisa (23) Garfield (48) Van Buren (37) Hawkeye (13) Harrison's Peach (12) Cheney (5)

The figures in parenthesis are the numbers attached to the varieties in the preceding lists.

I am indebted to Mr. Kerr, of Maryland, for some very accurate and interesting observations concerning the seasons of leading native plums and the dates of blooming. Tables II, III and IV contain this information :

TABLE III. ACTUAL DATES OF RIPENING OF NATIVE PLUMS ON THE CHESAPEAKE PENINSULA (KERR).

73	African	From July 20-Aug.	20
74	Arkansas Lombard.....	" 30- "	25
75	Caddo Chief.....	" 6-July	20
76	Coletta	" 20-Aug.	15
47	Cumberland.....	Aug. 1- "	25
91	De Caradeuc	July 15- "	10
8	Deep Creek.....	" 20- "	15
9	De Soto.....	" 25- "	20
77	Early Red.....	" 6-July	20
10	Forest Garden.....	" 25-Aug.	20
64	Forest Rose.....	" 20- "	20
48	Garfield.....	Sept. 1-Oct.	10
49	Golden Beauty.....	Aug. 20-Sept.	15
93	Hattie.....	July 25-Aug	15
66	Indiana Red.....	" 25- "	20
50	Indian Chief.....	" 20- "	5
17	Itaska.....	Aug. 1- "	25
81	Jennis Lucas.....	July 12-July	25
18	Kickapoo.....	" 25-Aug.	15
69	Leptune.....	Aug. 25-Sept.	30
82	Lone Star.....	July 8-July	25
23	Louisa.....	" 25-Aug.	20
92	Marianna	" 8- "	1
70	Miner.....	" 25- "	25
27	Minnetonka	Aug. 1- "	25
52	Missouri Apricot.....	Sept. 1-Sept.	25
53	Moreman.....	Aug. 25- "	30
83	Newman	July 30-Aug.	30
85	Pottawattamie	" 30- "	25
33	Purple Yosemite.....	" 25- "	20
34	Quaker.....	" 25- "	20
55	Reed.....	Aug. 25-Sept.	30
86	Robinson.....	July 30-Aug.	20
35	Rollingstone.....	" 25- "	20
56	Roulette.....	Aug. 1- "	20
87	Schley	" 5- "	25
59	Wayland.....	Sept. 1-Oct.	5

38	Wazata.....	Aug. 1-Aug. 20
39	Weaver.....	July 25- " 25
61	Wild Goose.....	" 10-July 30 or sometimes to Aug. 10
42	Wolf.....	July 25- " 25

Mr. Kerr has made a careful record of the periods of flowering of the native plums for this year,—which was unusually late,—and it is given below :

TABLE IV. FLOWERING PERIODS OF NATIVE PLUMS
ON THE CHESAPEAKE PENINSULA FOR 1892 (KERR.)

	First flowers open.	Half the flowers open.	All open.
73 African.....	April 19	April 25	April 27
1 American Eagle.....	" 29	" 30	May 1
74 Arkansas Lombard.....	" 23	" 26	April 28
94 Bassett's American.....	" 30	May 1	May 2
75 Caddo Chief.....	" 14	April 16	April 20
63 Clinton.....	" 27	" 29	May 1
76 Coletta	" 15	" 19	April 23
47 Cumberland.....	" 23	" 26	" 28
91 De Caradeuc.....	" 5	" 9	" 14
8 Deep Creek.....	" 23	" 24	" 26
9 De Soto.....	" 25	" 28	" 30
77 Early Red.....	" 14	" 16	" 20
10 Forest Garden.....	" 27	" 28	" 30
64 Forest Rose.....	" 27	" 29	" 30
48 Garfield.....	" 26	" 28	" 30
49 Golden Beauty.....	" 28	May 1	May 3
12 Harrison's Peach.....	" 27	April 28	April 29
93 Hattie.....	" 15	" 17	" 19
13 Hawkeye	" 27	" 29	May 1
66 Indiana Red.....	" 27	" 29	April 30
50 Indian Chief.....	" 25	" 27	" 29
67 Iris	" 26	" 29	May 1
17 Itaska	" 14	" 16	April 19
81 Jennie Lucas.....	" 14	" 22	" 25
18 Kickapoo	" 23	" 25	" 28
31 Le Duc.....	" 27	" 29	" 30
69 Leptune.....	" 27	" 30	May 1
82 Lone Star.....	" 20	" 25	April 28
23 Louisa.....	" 25	" 27	" 29
91 Marianna.....	" 7	" 15	" 19
70 Miner ...	" 25	" 27	" 29
27 Minnetonka.....	" 23	" 25	" 27

52	Missouri Apricot.....	"	27	"	29	May	2
53	Moreman.....	"	26	"	29	"	1
83	Newman.....	"	20	"	23	April	26
(70)	Parsons.....	"	25	"	27	"	29
85	Pottawattamie....	"	26	"	29	May	2
33	Purple Yosemite.....	"	27	"	28	April	30
34	Quaker.....	"	26	"	28	"	30
72	Rachel.....	"	28	"	30	May	2
55	Reed.....	"	26	"	29	"	1
86	Robinson.....	"	20	"	23	April	26
131	Rockford.....	"	27	"	29	"	30
35	Rollingstone.....	"	23	"	26	"	28
56	Roulette.....	"	25	"	27	"	29
87	Schley.....	"	23	"	27	"	29
36	Speer.....	"	23	"	25	"	27
57	Sucker State.....	"	25	"	27	"	29
37	Van Buren....	"	27	"	29	May	1
(83)	Warren.....	"	16	"	21	April	26
59	Wayland.....	"	26	"	28	"	30
38	Wazata.....	"	17	"	19	"	20
39	Weaver.....	"	25	"	27	"	28
60	Whitaker.....	"	27	"	28	"	30
61	Wild Goose.....	"	20	"	24	"	27
42	Wolf.....	"	27	"	29	"	30
43	Wyant.....	"	27	"	29	May	1
90	Yellow Transparent...	"	21	"	25	April	28

4. *Insects and diseases.*—Numerous insects and fungi attack the native plums. Much has been written concerning the supposed immunity of the fruit from the attacks of the curculio, and while it may be said that there is no curculio-proof plum, it is also true that the native varieties, as a rule, are less injured than the common or Domestic varieties.*

The fungi which do serious injury to the native plums are indicated for this paper by Dr. E. F. Smith, of the Division of Vegetable Pathology of the national Department of Agriculture, as follows :

"*The curculio prefers the domesticated to the native varieties of plums."
—C. P. Gillette, *Bull. 9, Ia. Exp. Sta. 388* (1890.) Other observers confirm this opinion. Professor Gillette finds that in central Iowa the plum gouger (*Coccoturus prunicida*) is very injurious, and it attacks the native more than the domestic varieties.

"1. The American varieties suffer little from septoria, or the shot-hole fungus of the leaves. (See Arthur, 5th and 6th reports N. Y. Exp. Sta., with which my observations coincide).

"2. Black-knot occurs on *Prunus Americana* in Michigan thickets, but I have never seen it upon the Chickasaws.

"3. The brown fruit-rot (*Monilia fructigena*) of the stone fruits attacks the native varieties, but they are more exempt, I think, than the varieties of *Prunus domestica*. As in the peach, the fungus attacks the twigs as well as the fruits.

"4. The leaf-rust (*Puccinia pruni-spinosæ*) is said to do injury in the southwestern states, but while I have seen it on peaches in many parts of the country, I have not found it upon the native plums.

"5. Plum-pockets or bladders (*Taphrina pruni*) is a frequent disease upon the native plums. It attacks the Americana and Chickasaw varieties and the Wild Goose. In Michigan I have seen it only on the fruit, which it changes into conspicuous bladders. In Maryland and Georgia it is common on shoots of wild Chickasaws and on cultivated Wild Goose, and it rarely attacks the fruit. It does considerable injury every spring.*

"6. An obscure blight often attacks native plums—as Wild Goose, Robinson, Marianna and others—causing the branches to die back during the growing season. The leaves and large branches and sometimes the whole tree wilt and become brown without apparent cause, and sometimes the tree dies. The roots do not appear to be involved, for they often send up healthy shoots after the entire top has died. This blight has been known in middle Georgia for several years and does more injury to plums than all other troubles combined.†

"7. The peach-rosette also attacks the native plums and perhaps is destined to make more trouble than any other disease in the south and west. (See Jour. Mycology iv. 143; same vi. no. 4; also bulletin of Div. Veg. Pathology on 'Additional Evidence of the Communicability of Peach Yellows and Peach Rosette.')

The fruit-scab (Fig. 11), which injures many varieties, is discussed for me by Professor L. H. Pammel, of the Iowa Agricultural College :

*See Smith, Jour. Mycology, iv. No. 3.

†Ibid.

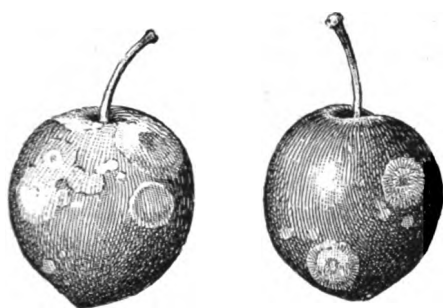


FIG. 11.—Fruit-scab. Natural size,

“Cladosporium carpophilum: So far, I have found this fungus only on the fruit, but in case of the peach Mr. Galloway records it upon the leaves as well. When plums are ripe or just turning in color, small round patches not larger than a pin-head make their

appearance. These spots are pale greenish or greyish in color and increase in size till in some cases they are half an inch across. They are mostly round with a somewhat paler border. In older specimens the patches are frequently confluent and of darker brown color. In very old specimens, especially in those where the fruit has undergone decomposition, the patches become black and uneven.

“A microscopic examination of the small greyish spots shows a nearly colorless mycelium creeping over the surface. In the darker portions of the large patches are septate hyphæ or threads. In some cases these come through cracks in the cuticle. The hyphæ are irregular in outline and frequently bent. As the material becomes older a dense stroma of short brownish hyphæ appears. This stroma lies between the cuticle and the cellulose layers of the cell-wall. Under favorable conditions it keeps on producing the erect septate hyphæ which bears the slightly colored spores at the end. The spores are oval in shape, pointed at the end, and usually two-celled. On placing the spores in water they germinate in a short time, producing a colorless tube from one of the cells.

“The disease does not impair the quality of the fruit, as the injury extends little beyond the spot, and affects only three or four layers of underlying cells. These cells take on a brown color, and have a slightly bitter taste. The greatest injury arises through the cracks which are frequently found in the older patches, which allow other fungi, like the fruit-rot, to work their way in. So it frequently happens that the rot accompanies the scab. The cladosporium or scab fungus causes the fruit to shrivel, in severe attacks.

"Here in central Iowa I have observed this scab upon the following varieties: Speer, Chippeway, Cheney, De Soto, Rollingsstone, Maquoketa (Fig. 11), Pottawattamie and Miner. It appears to be more or less local here as well as elsewhere in the United States. A correspondent has sent me specimens of the fungus on *Prunus Americana* grown in Virginia. The disease has also appeared in Canada, but principally on *P. Americana*, though in one case Professor Craig received specimens on the Blue Orleans (*P. domestica*) from Toronto. It is destructive, as he informs me, on Manitoba yellow plum, Cheney, Rollingsstone, DeSoto and Speer. The disease did not appear, according to Mr. Craig, in Canada on the Central Experimental Grounds last year. Here at Ames it has not appeared on *Prunus domestica*, but in addition to the above, it is found on *P. spinosa*. It has become a very destructive fungus on sour Cherry (*Prunus Cerasus*), damage amounting from 2 to 25 per cent. The disease is undoubtedly on the increase."

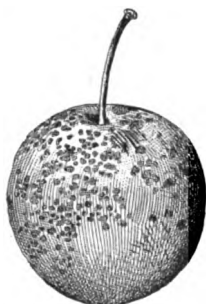


FIG. 12.—Fruit-spot.
Natural size.

A fruit spot (Fig. 12) has been sent me by T. V. Munson, Denison, Texas, on the Golden Beauty. The disease is said to be serious in some years. It does not injure the fruit greatly except to disfigure it and to render it unmarketable. I submitted the specimens to Professor J. E. Humphrey of the Massachusetts Agricultural College, who found the disease to be a phoma, but the exact species could not be determined. It is, no doubt, somewhat allied to the black-rot of the grape, and the treatment used for grapes should be tried upon the plum; and a similar treatment is advised for the fruit-scab shown in Fig. 11.

There are no data for determining the extent of the native plum industry, but it is safe to say that it is much more important than anyone, except those immediately concerned, has known. There are large areas of the country in which the common or *Domestica* plums do not succeed, either because of too great cold, too great heat or the serious ravages of the shot-hole fungus. In nearly all of these areas there are native varieties which succeed. The

natives are inferior in size and flavor to the common plums, but it must be remembered that the native plum industry is in its infancy, and that great results should not yet be expected. It is rather a matter of wonder that the present results have been attained with the expenditure of so little effort. The great variation in almost every direction in the existing varieties, and the fact that they spring from three or four distinct species, augur well for the future ; while the facts that they find ready sale in the markets* and that many people make their cultivation profitable, are encouragements to present effort.

*"And as for the Wild Goose plum, it is the best we have here. There have been shipped from here as many as 600 boxes of this variety in a single day, and have sold in the Chicago markets at the enormous price of \$2 per one-third bushel box, or \$6 per bushel."—*J. R. Logan, Duquoin, Ill., in Green's Fruit Grower, July, 1891.* Mr. Kerr sold Wild Goose readily in 1889 for 65 to 80 cents for 10-lb. baskets ; and in 1891 for 40 to 50 cents.

●

II. THE CHERRIES.

I. THE SAND OR DWARF CHERRIES.—(Figs. 13 and 14).—The dwarf sand cherry has often attracted attention as a meritorious fruit. In 1867, A. S. Fuller* published an important ac-



count of it and recommended its cultivation for fruit. In 1889, Professor C. E. Bessey called the attention of the American Pomological Society to it as "a prom-

ising new fruit from the plains" of Nebraska.† It is only within the last two or three years, however, that the sand cherry has come into actual cultivation for its fruit, although as an ornamental plant it has been sold many years. Professor C. A. Keffer described it last July in a bulletin of the South Dakota Experiment Station‡, and a little later Professor Green of Minnesota did the same.§ Both men have grown it, and have found it to be variable and promising. In South Dakota plants set three years bore heavily the second and third years. The "fruit begins to ripen the first week in August. The cherries on most of the bushes were ripe by August 20th, and some few last into September,

*Small Fruit Culturist, 1st Ed. 183.

†Amer. Pom. Soc. Trans. 1889, 160.

‡Bull. 26, S. Dak. Exp. Sta. 10.

§Bull. 18, Minn. Exp. Sta. 127.

showing a season of from four to six weeks in a seedling plantation. Classifying roughly according to the fruit, we find yellow and black fruited sorts. The yellow fruited sorts, as a class, are earlier than the blacks, and of rather better flavor. They are greenish yellow when fully ripe, and vary in size, the largest being about the size of a medium Early Richmond cherry." The fruits vary greatly in flavor, some being entirely worthless, while others were acceptable for some culinary purposes. "While of little value when the quality of the fruit is considered, it would seem that these dwarf cherries should give rise to a race especially adapted to the northwest. They have withstood all the dry weather of the past three years without injury, and they have been covered with bloom for two seasons, though unprotected during the winter." Professor Green, in Minnesota, has "fruit varying in color from quite light red to almost black, and in form from round-oblate to oval. The largest fruit we have is oval with three fourths inch and five-eighths inch diameters, while one other is round and eleven-sixteenths of an inch in diameter; this is nearly as large as the Early Richmond cherry. The quality varies greatly, some being a mild not disagreeable sub-acid, others insipid, and still others very astringent.

..... When cooked it makes a nice sauce. The period of ripening varies from July 24th to August 15th. A peculiarity of the plant is that all the fruit on any plant is ripe at nearly the same time and can all be gathered at one picking.

I consider this cherry not only of prospective value for its fruit, but of immediate value as a hardy shrub." I have been familiar with

the sand cherry for many years, both wild and when transferred to the garden. It is very abundant on the sand dunes of Lake Michigan, where it makes a shrub from five to ten feet high and bears very profusely of vari-



FIG. 14.—*Prunus cuneata*. Natural size.

able fruits. Some of these natural varieties are large, sweet and palatable and at once suggest an effort to ameliorate them. Professor Budd and others suggest its use as a dwarf stock for cherries*, while it is found to grow well, for a time, at least, upon the peach.† Finally, Charles E. Pennock of Bellvue, Colorado, is introducing the Improved Dwarf Rocky Mountain cherry, a description and history of which follow. I am particularly gratified to report this fruit because I remember with great distinctness that a "Rocky Mountain cherry" grew in my father's yard from my earliest boyhood. Pits were brought by a friend from Pike's Peak in an early day. As the western botanists do not mention any dwarf cherry, I have always been puzzled over this friend of my earlier years.‡ Mr. Pennock describes his cherry as follows:§

"I have never seen a bush more than four feet high. They should be planted about eight feet apart, as they grow on the ground. The first I ever saw or heard of was in 1878. I was making and floating railroad ties down the Cache la Poudre river, in the mountains, about eight miles from my present farm. I thought at that time they were the most valuable fruit I ever saw growing wild. I got a start of these cherries, and have been improving them by planting seed (pits) of the best fruit. They vary somewhat in size, flavor, and season of ripening, and are capable of great improvement. I have known only one bush that was not good in my experience with it. We have nearly all kinds of fruit, but we like the cherry to eat out of hand when fully ripe better than any of its season. It ripens a month later than Morello—in fact, I picked them off the bushes and exhibited at our county fair September 23d, 24th, and 28th, where they attracted a great deal of attention. I have learned since I have had these cherries that other residents of the county had them in their gardens more than twenty years ago, and have them yet, so I do not claim to be the discoverer of them, but I believe I am the first to improve them and make their value known to the public. They are very scarce in their wild state here. There are two kinds of them, one

*Bull. 10, Ia. Exp. Sta. 425. Bull. 18. Minn. Exp. Sta. 128. Bailey, Nursery-Book, 159.

† Bailey, Country Gent. li. 676 (Sept. 9, 1886.)

‡ Coulter's Manual of Rocky Mt. Botany contains no dwarf cherry.

§ Am. Farm and Hort. Apr. 1892, 14.

grows outside the mountains in the foot-hills, and is in every way inferior to the one that grows near the bank of the Cache la Poudre river. There are not 2,000 of these cherries of mine in existence. I could sell wagon loads of these cherries at 10 cents per quart. I have kept 200 of the young trees, which I intend to send to responsible parties who desire them for testing. The young trees I have are one year from seed. I have had them planted down at two years of age from seed. They have never failed to bear fruit every year; late frosts never affect them; they are entirely hardy, having endured 40 degrees below zero without injury; when all others are gone; would grace any lawn when in blossom; are easier pitted than other cherries."

Thus far, all appears to be simple enough; but if we begin to inquire into the species of these cherries we find great difficulty, and it is plain that two and perhaps even three species are passing under the name of *Prunus pumila*. Propagators have long recognized two well marked types of sand or dwarf cherry. The commonest species is the one shown, natural size, in Fig. 13. It grows along rivers and sandy or rocky coasts, from northern Maine (and probably from Newfoundland) to Washington, and perhaps even farther south, and ranges westward to the Great Lakes and Manitoba. I do not know if it grows on the sea shore, but aside from a specimen from Westbrook Co., Maine, I have not seen it from New England. It is a *prostrate* or *decumbent* shrub, the roughish dark branches ascending in a straggling manner three or four feet, or sometimes to that height. The flowers are rather small, with narrow petals. The leaves are *long and pointed* (nearly linear at flowering time), varying from oblanceolate to nearly obovate-lanceolate, or sometimes lanceolate, rather thick and firm and prominently veined, especially beneath, terminating usually in a sharp point and bearing on the upper half short but sharp teeth which, however, are usually smaller than shown in Fig. 13. This species is very variable. The form upon Lake Michigan is characterized by very long and willow-like leaves, and broad-leaved forms occur in other places. Nurserymen take advantage of its straggling habit by grafting it upon standard stocks for the purpose of making a weeping tree. It is sometimes sold as *Cerasus pumila*. A variety *variegata* of this weeping tree is catalogued, but I have not seen it. The sand cherry is the plant which

Linnæus meant to designate by his *Prunus pumila*.* It is the plant, apparently, which the experiment stations of South Dakota

* Linnæus founded the species upon a figure by Miller (t. 89, f. 2) and upon a plant cultivated in the Upsala gardens. Miller's figure, so far as it goes, and Linnæus' characterization, show that Linnæus meant to describe the prostrate and long-leaved plant which I have above indicated as *P. pumila*. Linnæus' herbarium affords no aid, according to the following notes upon it, which were recently made by Dr. N. L. Britton, and which he has kindly placed at my disposal. The herbarium contains

- "1. A sheet of the eastern plant [*pumila*], marked by him *pumila*.
- "2. Another sheet also marked *pumila*, but of some other species which I did not recognize.
- "3. Another sheet also so marked, but of some still different thing.
- "4. A fourth sheet from Kalm, which is *P. Americana*, as noted thereon by Dr. Gray."

The synonymy of the two species is briefly as follows :

PRUNUS PUMILA, Linn. Mantissa. 75.

"14. *Pruuus foliis angusto-lanceolatis serrulatis*

"*Cerasus foliis lanceolatis : glabris integerrimis, subtus caesia, ramis patulis*. Mill. ic. t. 89, f. 2.

"*Cerasus canadensis pumila, oblongo-angustoque folio, fructu parvo*. Hamel. arb. 149, n. 17.

"Habitat in Canada.

"*Frutex statura Amygdali nanæ. Pedunculi proprii, uniflora, terni e gemmis lateralibus*. H. U."

P. Susquehanæ, Willdenow, Enum. 519.

"*P. pedunculis subsolitariis, foliis obovato-oblongis, subtus glaucis, serratis, basi integerrimis*.

"*Prunus Susquehanæ*. Hortulan.

"Habitat in America boreali.

"Flores imperfectos tantum vidi."

In his Berlinische Baumzucht, 2d. ed. 306, Willdenow revises his character as follows :

"*Prunus Susquehanæ floribus umbellatis, foliis obovato-oblongis obtuse serratis, basi integerrimis, subtus glaucis*.

"*Prunus Susquehanæ pedunculis subsolitariis, foliis obovato oblongis subtus glaucis, serratis, basi integerrimis* Willd. enum. 519."

The German text which follows affords still stronger proof that Willdenow meant to designate the plant under consideration.

P. depressa, Pursh, Fl. 332.

"Umbels sessile aggregated, few flowered, calyx obtuse : branches angled depressed-prostrate ; leaves cuneate-lanceolate, rarely serrate, glabrous above, glaucous beneath ; fruit ovate.

"On the sandy shores of rivers and lakes : Canada to Virginia. v. v.

Minnesota have described, and it is the one which has been used as a dwarf stock for cherries.

Another and much rarer cherry is the one shown in Fig. 14, for which I have used Rafinesque's name *Prunus cuneata*. It grows near lakes and about bogs, mostly in wet or stiff soil, and is also found on hills and low mountains. I have seen it from Hampshire, Massachusetts, Rhode Island, New York (Catskills), New Jersey, Pennsylvania, North Carolina, Wisconsin and Minnesota. It is an *erect* or even *strict* shrub with smooth green colored branches, growing from two to four feet high. The flowers are large with broad petals, and usually stand out freely upon somewhat curved stems. The leaves are *short* and usually *blunt*, obovate, spatulate or when full grown somewhat elliptic-ovate and becoming more or less pointed, thin and inconspicuously veined, the teeth few and the points appressed.

This low shrub which spreads its branches very much, and does not rise above one foot from the ground, is known by the name of *Sand-cherries*. The fruit is black, small and agreeably tasted."

Prunus cuneata, Schweinitz in Long's *Exped.* 2, Append. 113. Bailey, *Annals Hort.* 1891, 234.

Through the kindness of Mr. J. H. Redfield, of the Philadelphia Academy of Sciences, I have had the privilege of examining Schweinitz's specimens (coll. at Lake of the Woods) and they are unmistakably *P. pumila*.

In all these descriptions, the long leaves, prostrate habit and the habitat, apply only to the plant under discussion.

PRUNUS CUNEATA, Rafinesque, *Ann. Nat.* 11 (1820).

"83. *Prunus cuneata*. Shrubby, branches straight, round, triangular, leaves cuneate, obtuse, crenate, base entire, glaucous beneath; umbels sessile, commonly quadriflore, calix serrulate, rugose transversally.—On the mountains of Pennsylvania, probably a Cherry shrub, it rises two feet, branches dark purple, leaves and flowers small, peduncles short, three to five flowers together, white; it blossoms in May."

The absence of any allusion to long leaves and depressed habit, the obtuse leaves and the mountain habitat, lead me to venture to use this name for the upright dwarf cherry. The leaves of this plant, to be sure, are often acute when mature, but at flowering time they are conspicuously obtuse, and Rafinesque appears to have had them at that stage.

This cherry is in cultivation as an ornamental plant under the name of *Prunus pumila*. I do not know that it has been suggested as a fruit plant.

Professor Porter, of Easton, Pennsylvania, one of the most critical observers of our eastern flora, writes as follows concerning these dwarf cherries: "We have two forms of dwarf cherry very diverse in habit. One [*P. pumila*] grows on the islands and flats of the Delaware, which are composed of gravel and cobblestone drift washed bare by the floods, and are treeless. Here it grows, sending out on all sides strong prostrate branches, often as thick as a man's arm, which form flat patches six feet or more in diameter. The branches are so close together that they hold the fine sand and mud and create low mounds or hillocks, and in the proper season the spaces between them are black with the fruit. The other [*P. cuneata*] occurs in southeastern Pennsylvania on the borders of swamps and remote from river bottoms. It is strictly erect and attains the height of four feet. It is so unlike the type that I have been inclined to regard it as a new species." On the dunes along Lake Michigan *Prunus pumila* grows more erect than those described by Professor Porter, but they always have a prostrate base over which the sand drifts. *P. cuneata* grows at Ithaca in a dryish hill swamp, and it wholly lacks the habit and appearance of the common species.

The third dwarf cherry is the Rocky Mountain plant to which I have already referred, and evidently the same as the one which Professor Bessey has described from the plains of Nebraska. This plant is not mentioned in the Rocky Mountain botanies, although there can be no doubt that it is wild in Colorado and Utah. Dr. C. C. Parry collected it in eastern Colorado in 1867, and apparently the same was found somewhere in the Rocky Mountains, presumably in Colorado, in 1888, by S. M. Tracy. A. S. Fuller also mentions it in the article to which I have already referred. He obtained the seeds from Utah. As compared with *Prunus pumila*, he found this Utah cherry to be "more erect, none of the branches trailing as in the species." Gipson* speaks of the native wild Colorado dwarf cherry as bearing a fruit "especially valuable for pies and preserves, and is often pleasant to eat from the hand.

*Horticulture by Irrigation, 62.

It is wonderfully productive, and will survive all changes and vicissitudes of the most exacting climate." It is interesting to find that this plant was collected so long ago as 1839 by Geyer, in Nicollet's famous expedition, being found on "arid sandy hillsides of the upper Missouri."

The affinity of this western plant is with *Prunus pumila*, but it differs from that species, and I am inclined to regard it as a distinct botanical variety, if not, indeed, a distinct species. It is a low straggling more or less prostrate plant, the tops rising only a foot or two in the plains form, the flowers small, the leaves much like those of *P. pumila* except that they are much shorter (1 to 2 in. long) and spatulate or elliptic when fully grown, the fruit large upon short stems. This plant is so little known that I do not venture to give it a name. Growing in our garden, it has more the aspect and light color of *P. cuneata*, but its thick and pointed leaves appear to distinguish it from that species. It lacks entirely the wand-like and willowy character of *Prunus pumila*; but this species is so variable and so little understood that it would be unsafe to separate the western plant from it upon our present evidence. We are growing this western cherry, as also *Prunus pumila* and *P. cuneata*, from various sources and shall probably soon be able to determine its botanical position.

The sand or dwarf cherries, therefore, are three, all of which are in cultivation: *Prunus pumila*, the true sand cherry grown for fruit and ornament; *Prunus cuneata*, grown for ornament; the sand cherry of the plains and the Rocky Mountains, grown locally in Nebraska and now introduced from Colorado as the Improved Dwarf Rocky Mountain Cherry. Finally, it may be said that the sand plum is a form of the Chickasaw plum as we have already found (See p. 29).

2. "UTAH HYBRID CHERRY."—Under this name there has come into cultivation an anomalous fruit, the history and botanical characters of which I am unable to trace. It is usually referred by the nurserymen to *Prunus pumila*, but the specimens which I have seen do not belong to that species. In fact, as grown by Mr. Kerr, it is a plum, with a stone very like that of the Marianna, and the catalogue cut of the fruit shows a short-stemmed and sutured plum. There are two varieties in cultivation, the black and red. These are described as follows by the

Heikes Nurseries, of Dayton, Ohio, which was one of the first to grow them :

" *Utah Hybrid Cherry, black.*—This is an improved variety of the Dwarf or Mountain Cherry of Utah. The fruit is about one inch in diameter, nearly round ; color dark purple, with a delicate bloom, juicy, pleasant and sweet ; slightly astringent if the skin is pressed too closely. The bush is very dwarfish, but vigorous and prolific. This fruit has the merit of being something entirely distinct from anything cultivated in the way of fruits heretofore. The fruit is exceedingly beautiful; the tree is hardy enough to withstand the severest winters, and begins to bear the first year after planting.

" *Utah Hybrid Cherry, red.*—This is a dwarf variety, evidently belonging to the Chickasaw class, and while it has some merit as a novelty, it is not nearly equal to the above."

Samuel Miller, of Bluffton, Mo., informs me that he obtained the Utah Hybrid Cherry over ten years ago from Nebraska. The Phoenix Nursery Company, of Bloomington, Ill., "have been propagating it for many years" to supply the spontaneous demand for it, but the Company writes me that it "cannot recommend it" and that "the fruit is rather small, of dark purplish red color, and is merely a skin drawn over a pit." The plant sold by the Phoenix Company is a slender under-shrub with elliptic-lanceolate prominently nerved and pointed leaves which are sharply serrate throughout, and which cannot be referred to any form of *Prunus pumila* with which I am acquainted. The tree grown by Mr. Kerr has the half-weeping habit of a Morrello cherry, and the leaves are also very like those of the Morello. The flowers are borne in short-stalked umbels upon wand-like twigs, and they suggest, as do also the leaves, an approach to *Prunus maritima*, the beach plum. The original Utah Hybrid which Mr. Kerr planted, he tells me, had fruit about the size of Bassett's American (See No. 94, Part I), but which ripened earlier than that plum. The present tree, described above, is a seedling of it, but this seedling has larger fruit—as big as a large Napoleon cherry—which is later than the Bassett, and the tree is less dwarf. He considers the Utah Hybrid an inferior fruit.

3. *PRUNUS SEROTINA*, the Wild Black or Rum Cherry. This well known cherry, the wood of which is often used for cab-

inet work and house finishings, is planted for forestry purposes, as an ornamental tree and sparingly for its fruit. Infusions of the bark are used for medicinal purposes and the fruit is often used in the manufacture of cherry brandy or as a flavor to rum. Occasional trees bear fruit of unusual size and attractiveness. As an ornamental plant the Wild Black Cherry possesses decided merits in its attractive habit, clean shining foliage, striking white racemes and handsome fruit. There are several cultivated varieties: *pendula*, a weeping form, worked standard high; *variegata*, with the leaves more or less discolored with yellow; *Golden-Leaf*, found wild by Jackson Dawson, of the Arnold Arboretum, and somewhat disseminated, and probably essentially the same as *variegata*; *carthagena*, with small short-elliptic or ovate-elliptic leaves. *Prunus serotina* ranges through the eastern and southern states as far west as Kansas.

4. *PRUNUS PENNSYLVANICA*, the Bird, Wild Red, Pigeon or Pin Cherry, is occasionally cultivated for ornament, although it is not so well known as its merits deserve. It sprouts badly, a feature which no doubt discourages its dissemination. The species has been lately recommended as a stock for the common orchard cherries.* Professor Budd says that "when top-worked or crown-grafted with vigorous growing sorts it does not appear to have any reserve material to waste in sprouts. We have trees of the Early Richmond and Dyehouse in the state which have not shown a sprout on this stock for twelve years." The union with the orchard cherries, both sweet and sour, appears to be good as a rule, and the species certainly possesses promise as a cheap and hardy stock. The fruit is sometimes used in the preparation of cough mixtures. It is generally distributed throughout the northern half of the Union from the Atlantic to Colorado.

5. *PRUNUS VIRGINIANA*, the Choke Cherry, is cultivated for ornament. It is scarcely inferior for that purpose to its Old World congener, the true Bird Cherry (*Prunus Padus*), although its flowers are somewhat smaller than in that species, and they are also a few days earlier. If grown as a lawn tree where a symmetrical development can be secured, the Choke Cherry, both in bloom and in fruit, is an attractive object. Although rarely more

*Budd, Bull. 10, Ia. Exp. Sta. 425. Bailey, Nursery Book, 159.

than a large tree-like bush, the Choke Cherry is often confounded with the Wild Black Cherry, but it is readily distinguished by the very sharp small teeth of the leaves. The fruit of the Choke Cherry is commonly red, but amber-fruited plants are occasionally found. This cherry has been mentioned as worthy of attention as a fruit plant, but the fact that none of the racemose cherries (those bearing their flowers in long clusters) have given marked results in this direction, indicates that efforts towards amelioration of the fruit are likely to meet with discouragement. The Choke Cherry is generally distributed east of the Rocky Mountains.

6. *PRUNUS DEMISSA*, the Western Choke cherry, was introduced in 1881 as an ornamental plant by Edward Gillett, Southwick, Mass. Its merits as a cultivated plant are not yet well known. It is much like the Choke Cherry, but more variable in stature and apparently in botanical characters. It occurs from Nebraska to the Pacific coast, extending the length of California and Oregon.

7. *PRUNUS ILICIFOLIA*, the "Islay" of southern California and western Arizona, was introduced to cultivation last year by C. R. Orcutt, of San Diego, California. It is a pleasing ornamental plant with holly-like evergreen leaves (whence the name *ilicifolia*), and a small astringent reddish fruit. In its wild state it reaches a height of 10 or 15 feet. Its merits for cultivation in eastern lawns are yet to be determined.

8. *PRUNUS CAROLINIANA*, the Cherry Laurel, Wild Orange, Mock Orange, or Wild Peach of the southern states, is in cultivation in the south as a small ornamental tree and as a hedge plant. The leaves are long, thick and glossy, and are evergreen. The white flowers are borne in small racemes which are shorter than the leaves. The small black fruit soon becomes dry and is not edible. The species grows wild along rivers from North Carolina to Florida and Texas.

REVIEW.

I. PLUMS.

1. The native plum industry dates from the dissemination of the Wild Goose some 40 years ago. It is only within the last decade, however, that this industry has assumed great importance.

2. Five species and one botanical variety of native plums are now in cultivation for their fruits. 140 named varieties are described in the preceding pages, very many of which are wild varieties transferred to cultivation.

3. Nearly all the commercial varieties belong to three species, —*Prunus Americana*, *P. hortulana* and *P. angustifolia*. These species grow wild in regions east of the Rocky Mountains.

4. *Prunus Americana* grows the farthest north of any of the native plums, and its varieties are the hardiest of any. The species also grows as far south as northern Mexico. The range of adaptability of its varieties may therefore be assumed to be very great. The species is naturally variable, and is therefore attractive to the horticulturist.

5. The fruit of *Prunus Americana* is firm and meaty, usually somewhat compressed or flattened, often marked by a distinct suture, dull in color which ranges through various shades of red and purple to an ill defined and blotched orange. The skin is thick and tough, often acerb, and covered with a pruinose bloom. The stone is large and more or less flattened and winged, and is sometimes nearly or quite free, and the surface is either slightly pitted or perfectly smooth.

6. Forty-five varieties are referred to *Prunus Americana* in the preceding lists. The most popular of these are Cheney, Deep Creek, De Soto, Forest Garden, Itaska, Louisa, Purple Yosemite, Quaker, Rollingsstone, Weaver, Wolf. The Americana varieties succeed best, on the whole, in the northern states of the Mississippi valley, as in Wisconsin, Iowa and Minnesota. Some of them, however, are successfully grown in Texas, and on the Atlantic slope so far south as 37° or 38°.

7. *Prunus hortulana* grows wild in the Mississippi valley from northern Illinois to Arkansas, extending eastward into Ken-

tucky and Tennessee and possibly farther, and in the southwest spreading over a large area of Texas. It is naturally variable and has given many important cultivated varieties. It has never been recognized as a distinct species until this year. There are two or three distinct types represented in the species, one of which—the Miner group—appears to possess some radical points of difference from the typical representatives of the species.

8. The fruit of *Prunus hortulana* is firm and juicy, spherical or spherical-oblong, never flattened, and in color ranges through several shades of bright red to clear pure yellow. The skin is thin, often marked with small dots, and is usually covered with a thin bloom. The stone always clings; it is comparatively small, rough, turgid, sometimes prolonged at the ends, but is never prominently wing-margined.

9. The Wild Goose is the best known of the native plums, although its quality is not high. This popularity is due to its productiveness, earliness, beauty, good shipping qualities and to the circumstance that it was early introduced to cultivation. This variety is grown from Iowa, Michigan and New York to Georgia and Texas.

10. The Wild Goose group of plums, as a whole, is well suited to the middle latitudes. The most prominent members of the group are Golden Beauty, Indian Chief, Missouri Apricot, Moreman, Wayland and Wild Goose.

11. The Miner group differs from the Wild Goose or true *Hortulana* group by dull and comparatively thick leaves which are conspicuously veiny below and irregularly coarsely toothed and more or less obovate in outline, and by a rather late and very firm fruit and a flat and nearly or quite smooth stone. The varieties are all much alike. In a wild state, this form of native plum probably grows from Illinois to Tennessee and Arkansas.

12. Ten varieties are referred to the Miner group, of which the most prominent is the Miner. This variety was the first native plum to receive a name from horticulturists. Its history runs back to 1814. Seventy years ago it was known as Old Hickory and General Jackson. Next to the Wild Goose, the Miner is the best known of the native plums. It is hardy in northern Illinois and is popular in the central and some of the southern states.

13. The Chickasaw plums are characterized by slender, spread-

ing and zigzag growth, comparatively small lanceolate or oblong-lanceolate conduplicate (or trough-like) leaves which are shining and closely and finely serrate, and by an early red or yellow soft stringy fleshed fruit which is more or less dotted, and a clinging broad roughish stone. In a wild state, the Chickasaw plum is usually thorny and the thorns persist in a few cultivated varieties. The species grows wild from southern Delaware to Florida and westward to Kansas and Texas.

14. The most important varieties of Chickasaw plums are Caddo Chief, Jennie Lucas, Lone Star, Newman, Pottawattamie, Robinson and Yellow Transparent. The Newman is the most generally known and this is hardy in central New York. The Chickasaws are best adapted to the central and southern states. Many of them are not hardy in Michigan and New York.

15. The Marianna and DeCaradeuc constitute a distinct class or group of plums, and the Hattie is evidently allied to them. They are to be associated with the myrobalan plum. DeCaradeuc is probably myrobalan, and Marianna appears to be a hybrid. The history of the myrobalan is obscure, but it is clearly of Old World origin. It is largely used as a stock, and there are varieties grown for fruit.

16. The Marianna has assumed great importance because of its use as a stock for many plums and allied fruits. Its merits are the ease with which it grows from cuttings, and the facility with which it unites with other species.

17. The beach plum or *Prunus maritima*, of the Atlantic Coast, is in cultivation both for ornament and for fruit. As a fruit plant it is represented only in Bassett's American, a fruit of little value.

18. The Pacific wild plum, *Prunus subcordata*, was introduced to cultivation in 1889 as a possible fruit plant, but its merits are not yet determined.

19. Hybrids appear to occur between the Wild Goose and the peach. J. W. Kerr, of Maryland, has produced such a hybrid, and the so-called Blackman plum appears to be another.

20. Some varieties of native plums, notably Wild Goose and Miner, are not fertile with themselves, and this fact has undoubtedly retarded the progress of native plum culture. This infertility is due to comparative impotency of pollen upon flowers of

the same variety rather than to any structural imperfection in the flowers themselves.

21. This infertility is avoided by mixed planting, by means of which foreign pollen is supplied to the impotent varieties. Care should be taken to associate varieties which bloom at the same time, and with this precaution the ordinary mixed or alternate planting, at usual distances, appears to be successful.

22. The best stocks for native plums are probably seedlings of the same species, although they grow well, as a rule, upon related species and even upon the peach in some instances. Perhaps the most popular stock at present is the Marianna, because of its habit of growing readily from cuttings, and so far it appears to have given satisfaction. The Chickasaw and Hortulana types succeed well upon the peach. Chickasaw stocks sprout so badly that they are in disfavor. In the north, Americana stocks are popular for all the varieties which succeed there.

23. As to the best varieties, there is great difference of opinion. In the northernmost states the Americana class is most reliable, although some of the Hortulanas succeed. For the south the Chickasaws are numerous and popular. The Hortulanas occupy an intermediate position. The merits of particular varieties must be gleaned from the tables on page 48 and succeeding pages.

24. The native plums are in most regions comparatively free from insect abuses. Although there are no curculio-proof plums, the curculio does less damage to the native varieties than to the common or Domestica types.

25. Among diseases, a mysterious blight and the peach-rosette are prominent in the south. A fruit-scab and fruit-spot also occur. The septoria or shot-hole fungus—which causes the serious shedding of leaves in the Domestica plums—does little damage upon the natives. The black-knot, brown fruit-rot and plum-pockets are other diseases which the grower will be likely to meet.

26. As a whole, the native plum industry has made astonishing progress and it has already assumed large proportions. It is certain to occupy a large place in future American horticulture.

II. CHERRIES.

27. Eight and perhaps ten species of native cherries are in cultivation. Of these, three are grown for fruit, and all but one or two are cultivated for ornament. None of the species have gained much prominence under cultivation, however. Most of them are of comparatively recent introduction.

28. The so-called dwarf or sand cherries are much confused, and two, perhaps three species, are passing as *Prunus pumila*: (a) The true *P. pumila*, or sand cherry, is a low straggling shrub, growing along rivers and coasts from Maine to Pennsylvania and Manitoba. It has long thick leaves, and produces cherries of variable size, color and quality. Some of these varieties give great promise as garden fruits, and they are already under test at experiment stations. The plant is also being tested as a stock for dwarf cherries. (b) *P. cuneata* is a slender upright shrub with larger flowers and shorter obtuse spatulate or obovate thin leaves growing in cooler lands from New England to North Carolina and Minnesota. It is in cultivation as an ornamental plant under the name of *Prunus pumila*. (c) The representative of *P. pumila* upon the plains of Nebraska and in the Rocky mountains is a very low plant with short thick leaves and large short-stemmed fruit, the botanical position of which is yet unknown. It is now in cultivation as the Improved Dwarf Rocky Mountain Cherry.

29. The Utah Hybrid Cherry is a fruit of uncertain value and doubtful affinity. Two varieties, the black and red, are in cultivation. It probably comes from some part of the western plains or the Rocky mountain region, but its wild prototype is not known.

30. Other native cherries in cultivation are: *Prunus serotina*, the Wild Black Cherry; *P. Pennsylvanica*, the Bird, Pin or Wild Red Cherry; *P. Virginiana*, the Choke Cherry; *P. demissa*, the Western Choke Cherry; *P. ilicifolia*, the Islay of the Pacific slope; *P. Caroliniana*, Cherry-Laurel or Mock Orange of the Southern States.

L. H. BAILEY.

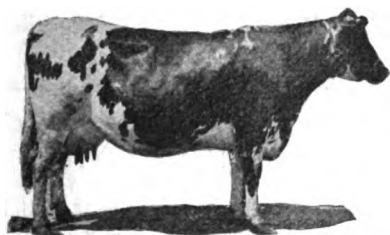
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Cornell University Agricultural Experiment Station.

AGRICULTURAL DIVISION.

Creaming and Aerating Milk.



By **HENRY H. WING.**

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BULLETINS OF 1892.

- 38. The Cultivated Native Plums and Cherries.
- 39. Creaming and Aerating Milk.
- 40. Removing Tassels from Corn.

CREAM RAISING BY DILUTION.

It is well known that where cream is separated from milk by deep setting gravity process, the best results are obtained when the temperature of the milk is quickly brought down to and maintained at about forty degrees for twelve hours. The winter of 1889-90 was so warm and open that many dairymen failed to secure a supply of ice and in the ensuing summer began to suffer loss because they were not able to sufficiently lower the temperature of the water surrounding the cans in their creamers. To obviate this difficulty it was recommended that water should be added to the milk to facilitate the creaming. Two different plans were mainly recommended: one, that twenty-five to thirty per cent. of hot water (135 deg. F.) be added to the milk in order to raise the temperature of the whole mass to at least one hundred degrees, so that in cooling down as low as possible,—usually to about sixty degrees F—there would be approximately the same range of fall as there would be in cooling down to forty degrees with ice. The other recommendation was that an equal amount of cold water (60 deg.) be added to the fresh milk before creaming. This was based on the idea that the increased fluidity given to the milk would render the creaming process as complete as though the milk were cooled down to forty degrees with ice.

Since that time, experiments to test the value of these recommendations have been conducted at several of the experiment stations and the results are found in the following publications: University of Illinois Experiment Station Bulletin No. 12, page 10, and Bulletin No. 18, page 30. Cornell University Agricultural Experiment Station Bulletin Nos. 20 and 29. Vermont Agricultural Experiment Station, Newspaper Bulletin No. 3, and 10th Annual Report, pages 100-107.

not, therefore, be accepted as accurate measures of the heating capacity of any apparatus. It follows that the performances of two systems can be studied nearly as well in houses of different construction as in similar ones, for the house is to a certain extent eliminated from the problem and the actual work of the apparatus is considered. The heat must be measured in and on the pipes; after it leaves them it is largely beyond our control. And the dissimilar houses present the actual conditions of commercial establishments better than the others.

All our experience emphasizes the greater value of steam, but it must be understood that we do not condemn hot water. Steam is certainly better for our conditions, and we believe that it is superior for very large houses where the fall is slight, for most forcing-houses, and for all establishments which are likely to be often modified and extended. For conservatory purposes, for straight runs and small houses, it is perhaps equalled—possibly surpassed in some instances—by hot water. Steam overcomes obstacles, as elbows and angles and obstructions, better than hot water. It travels faster and farther. Crooked runs with little fall are great difficulties in hot water heating. Steam can be varied more quickly than hot water. On the other hand, steam is as steady as hot water under proper management, and it requires no more attention. In our own experience, the same treatment is given both heaters. Plants thrive as well under steam heat as under hot water heat. The opinion that steam heat is a “dry heat” is erroneous.

Hot water heating demands from a third to a half more piping than steam heating, and the original cost is therefore greater. This additional piping has a certain advantage, however, inasmuch as each pipe is less hot than in steam systems and is less likely to injure plants which stand close to it. This advantage is not great, however, especially in forcing establishments where no injury need ever come from hot steam pipes. In this connection it may be said that hot water for forcing establishments is most satisfactory when conducted in wrought iron or gas pipes, in essentially the same manner as steam. It remains to be said that in all our houses, comprising over 6,000 square feet and described in the sequel, we shall in the future use steam heat from a horizontal tubular boiler.

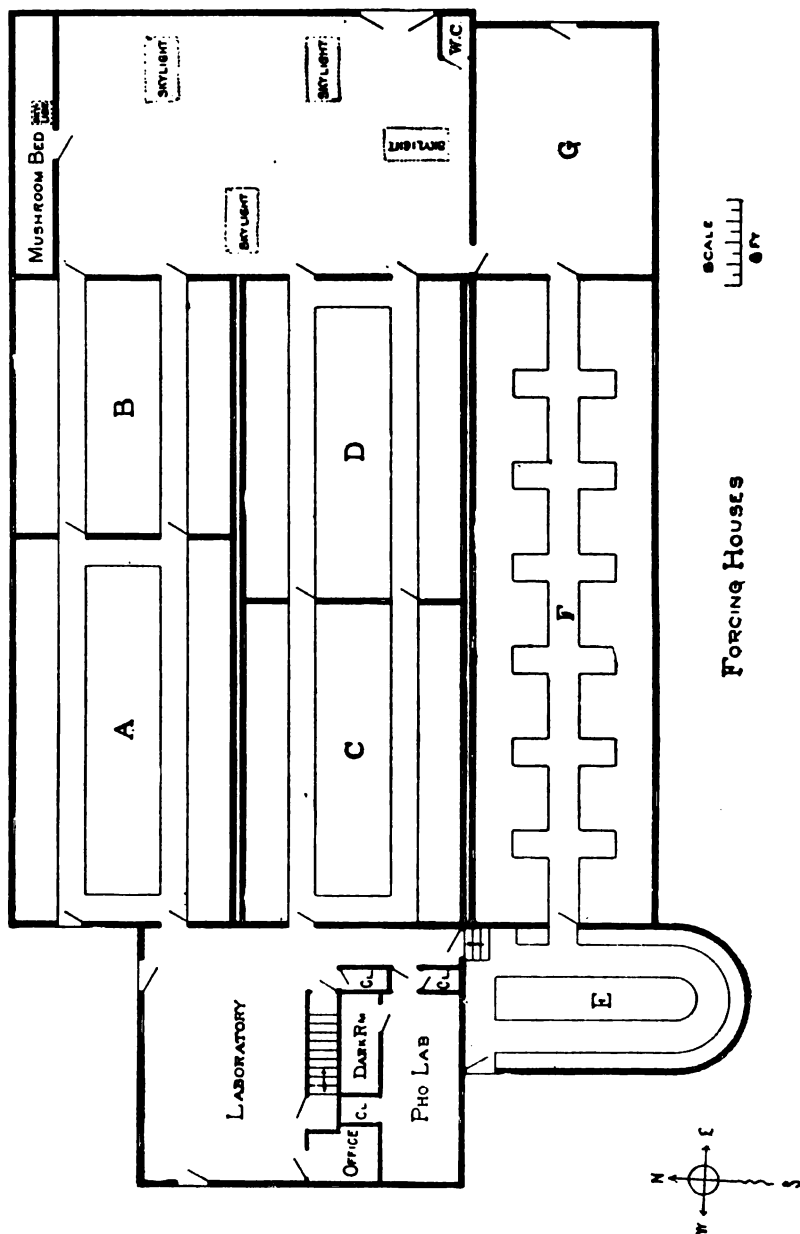
L. H. BAILEY.

THE COMPARATIVE MERITS OF STEAM AND HOT WATER FOR GREENHOUSE HEATING.

I. EXPERIMENTS AT CORNELL.

The question of the comparative merits of steam and hot water heating horticultural buildings has received much attention from practical men. Experiments have also been made by Professor Maynard, of Massachusetts, and Professor Taft, of Michigan, in comparing the coal consumed and the temperature obtained in houses of similar construction, with all the conditions as nearly alike as possible. The object of the present observations is to learn, if possible, something more concerning the workings of the two systems, which should have a practical bearing on the subject.

Methods. General records.—These experiments were made in University forcing-houses, a ground plan of which is shown in diagram, Fig. 1. A B is a low house 20x60 feet, with three-fourths span, the north walk and benches being higher than those on the south side. It is a cool house, used mainly for lettuce and cabbages, and is divided into two apartments by a board partition. It has a roof pitch of about 22° on the south side and $26\frac{1}{2}^{\circ}$ on the north side. In the second series, which has the same ground plan, house C has a steep roof with the gable 11 ft. above the walk. The south slope of this house C is at an angle of some 40° , and the north slope about 42° . The roof of house D has an angle of nearly 40° on the south, and 39° on the north side. A cross-section of house D is shown in Fig. 2, page 120. Both houses have a three-fourths span with lower benches on the south side. C is used principally for tomatoes, D for cucumbers and beans. House E is an experimental or conservatory attachment, with glass sides and high roof. F is a laboratory house 16x60 feet., about 9 ft. high at the



gable, having an even span with a roof slope of about $38\frac{1}{2}^{\circ}$. G is a continuation of the same structure, but has a lean-to hip roof. It is 16x24 ft. It is without benches, separated from F by a glass partition, and is now covered with cloth, being used as a cool propagating house.

The boilers are located near each other in the cellar, under the room marked Laboratory, in the plan. The steam heater is a No. 6 Furman, made by the Herendeen Manufacturing Company of Geneva, N. Y., a low pressure boiler which, according to the manufacturers' estimate, contains 175 sq. ft. of heating surface. The hot water heater is one made by the Lansing Engine and Iron Works and contains 175 sq. ft. of heating surface. The water is forced through the pipes by the pressure of an expansion tank standing 14 feet above the heater. The steam boiler heats the north and middle series (A B, C D), and the mushroom pit. Pipes also run into the photograph laboratory and to a small radiator in a living room over the Laboratory. Two 2-inch overhead risers carry the steam from the heater, one riser supplying the series A B, and the other the series, C D. The return from each riser is carried by seven $1\frac{1}{2}$ -inch pipes, there being two under each side bench and three under the center bench. Fig. 2 shows the method of piping. The riser will be seen near the peak and the seven returns under the benches. The hot water plant heats the house E, containing some 350 sq. ft., the lower house F, and the cloth house G. A coil also runs into the workroom at the rear, but practically very little heat gets into this. Four 2-inch risers carry the hot water, two overhead risers supplying the long house F, one the house E, and one the cloth house G. Observations on the hot water plant were taken only in one run in the long house F. The returns in this case comprise a vertical coil of six $1\frac{1}{4}$ -inch pipes connected at the extremities by manifold tees, and passing under the bench. At the boiler end this coil is condensed into two $1\frac{1}{4}$ -inch pipes, one taken from the top of the manifold tee and one from the bottom. It is interesting to know that the average temperature is 11 degrees higher in the upper one of these pipes, showing that the return water preferred that pipe. The riser for house G passes under the benches of house F. Common wrought iron pipes are used throughout the establishment.

The various character of these houses necessitates many elbows

and fittings in the piping and the fall is slight; these are conditions to which water is not adapted. But as these are the conditions which are usually present in commercial establishments, our results must have an intensely practical bearing. Steam overcomes difficulties much more readily than hot water. Our hot water system is put in after the most approved fashion, and the following tests concern the actual merits of the two systems under practical conditions. In perfectly straight and simple runs, the results might be very different.

The observations were made by inserting thermometers near the boiler inside the riser and return of each series of houses, and placing others on the outside of the risers at the extreme ends of each series. Table I shows the temperatures at all these points, morning and night, from Jan. 18 to Feb. 29, 1892, together with the steam pressure, if any, the outdoor temperature, and the temperature of each of the houses. It should be borne in mind that houses A and B are purposely kept cool, for growing plants requiring a low temperature. The ventilators were often open, as noted by the letter V in the table, while the doors between the cool workroom and both steam series were generally open. These conditions would lower the average temperature shown by these steam houses. The thermometers used for the inside temperatures were let into the interior of the steam pipes through a fourth-inch tap or hole, and were made tight by a filling of putty; they remained permanently in this position during the whole experiment. These were glass thermometers of very delicate make. Those used on the outside of the pipes were placed so that the bulb rested on the pipe, the bulb being imbedded in a ball of putty to offset the effect of air temperatures as far as possible. These were placed on the risers at opposite ends of all the houses, and are the ones corresponding to letters A, B, C, D, E, F, in the following table. These thermometers stood in the houses indicated by their letters: A, B, C, D, in houses A, B, C, D, respectively, or the steam houses; E, F, in the hot water house F, E being at the west or boiler end and F at the farther end. The thermometers inserted inside the pipes are designated by small letters, to correspond with the respective series of houses. Part of these latter are in the risers and part in the returns, as indicated in the table. These inside riser thermometers were inserted near

heater, before the riser entered the house; and the return thermometers were inserted near them or after the pipes had left the house.

Return thermometer a b is inserted in the pipe which takes return from the middle and upper benches of house A and those from the lower bench passing back by a separate pipe to the general steam return. Return thermometer c d is in the pipe which carries the return from all the runs of house C and D. The mercury in this thermometer was occasionally found to fluctuate back and forth with a comparatively uniform and rapid motion.

Whenever this was the case, the figures are given which show the extent of the range. This thermometer being in the return near the boiler, there was probably a backward pressure at times, forcing some of the heat into the return, which at this point is below the water level in the boiler, and nearly horizontal. A slight tendency to a similar action was noted in the other service or twice (return a b) but that thermometer is in an upper portion of the return, nearly as high as the top of the boiler, where such an effect was not to be expected.

It will be seen by the table that on the mornings of Feb. 23, 25, 26 and 29, there was practically no circulation in the pipes of houses C and D. These were warm mornings and the fires were low, hence in computing the averages of the thermometers this run more reliable figures are obtained by disregarding the observations, and such modified figures are used in common in the summary of Table I, although the actual averages obtained by including these are also given in parentheses. This has little importance in the return, where the temperature is so variable, for it there modifies the average but slightly.

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TABLE I—GENERAL TEMPERATURE RECORDS.—JAN. 18-31, 1892.

Date.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.
Time of day	5:30	8:45	5:20	8:20	5:30	8:15	5:30	8:20	5:30	8:15	5:20	8:20	5:30	8:30
Steam pressure.....	—	—	—	3	0	0	0	0	1½	0	1½	0	0	0
Riser, a b.....	210	210	210	217	210	210	210	210	212	217	222	213	220	213
Riser, A.....	191	192	190	199	192	189	190	195	192	193	197	192	192	196
Riser, B.....	182	182	181	187	182	181	182	186	186	184	184	187	183	182
Return, a b.....	172	180	152	112	209	184	160	153	180	183	195	201	202	179
Riser, c d.....	210	210	210	211	218	211	211	211	210	212	218	224	214	221
Riser, C.....	195	195	195	194	198	196	196	196	192	197	198	198	198	198
Riser, D.....	190	190	189	189	197	189	191	189	190	193	193	191	192	191
Return, c d.....	92	137	128	170	162	116	116	127	84	142	137	159	166	143
Riser, f.....	145	175	173	174	180	165	181	145	162	176	188	159	150	137
Riser, E.....	122	153	149	152	162	146	162	126	141	153	162	143	134	124
Riser, F.....	101	142	134	142	153	134	152	108	127	143	156	137	120	107
Upper return														
f, (see p. 111)	108	135	138	137	146	125	144	105	126	138	145	133	121	107
Lower return	99	123	125	125	134	119	131	96	118	126	132	121	111	97
Turn, f.....														
Outdoor room	32	18	13	—	3	13	21	26	32	34	27	30	32	33
House, A.....	60	59	60	52	64	62	59	60	64	70	64	76	73	72
House, B.....	61	59	60	54	65	64	56	57	63	72	62	80	77	76
House C.....	58	60	59	59	68	66	68	63	60	71	69	79	72	69
House, D.....	58	62	57	52	61	61	61	58	60	68	64	72	68	68
House, E.....	58	62	67	62	68	65	68	58	67	76	68	77	69	64
House, F.....														

LEGEND.—Capital letters indicate temperatures on the outside of the risers. Small letters indicate temperatures inside the risers and returns. A, B, C, D, a, b, c, d, refer to steam temperatures in all cases, and E, F, e, f, to hot water temperatures. The letters, except E, e, also correspond to the respective houses.

TABLE I.—GENERAL TEMPERATURE RECORDS.—FEB. 1-13, 1892.

Date.	1.	2.	3.	4.	5.	6.	8.	9.	10.	11.	12.	13.
Time	8:30	5:20	8:30	5:20	8:30	5:30	8:20	5:20	8:30	7:15	8:20	8:30
Steam Pressure	0	0	3	0	0	0	0	0	0	0	2	3
Riser, a b.....	210	210	218	210	210	211	218	209	210	209	215	205
Riser, A.....	192	192	190	198	192	194	194	190	191	190	188	195
Riser, B.....	181	183	181	188	182	180	181	186	182	184	181	190
Return, a b.....	109	147	105	206	105	200	105	175	152	108	182	204
Riser, c d.....	210	210	210	218	210	214	210	210	210	210	210	210
Riser, C.....	196	196	195	202	194	199	195	195	195	199	194	202
Riser, D.....	191	190	190	197	191	194	191	194	191	192	189	196
Return, c d.....	60	150	71	150	72	152	84	155	142	135	119	162
Riser, f.....	129	161	146	191	140	173	151	146	147	155	163	182
Riser, E.....	116	146	129	136	123	152	133	132	130	138	142	158
Riser, F.....	113	128	118	148	110	130	112	114	112	117	121	138
Upper Return, f	103	127	121	151	114	139	118	117	110	119	123	141
Lower " f	94	116	108	135	112	126	107	105	99	107	110	125
Outdoor Temp.	34	37	38	42	28	31	28	21	17	5	24	40
House, A.....	64	68	67	72	58	68	64	62	56	50	58	65
House, B.....	68	68	48	68	62	69	70	65	64	56	58	71
House, C.....	66	73	65	70	60	76	65	68	60	54	66	68
House, D.....	65	68	65	66	64	68	65	64	60	60	54	65
House, F.....	66	70	69	70	60	73	67	62	60	59	60	69

Pipe Readings.

Air Readings.

TABLE I.—GENERAL TEMPERATURE RECORDS.—FEB. 15-29, 1892.

Date.	15.	16.	17.	18.	19.	20.	22.	23.	24.	25.	26.	27.	29.
Time.	8:30 10:	8:30 8:	8:30 8:	8:20 8:	8:20 8:15	8:30 5:	8:30 9:	8:30 8:	8:30 5:30	8:30 6:	8:30 5:	8:10 5:30	8:30 5:30
Steam pressure...	$\frac{1}{2}$ 2	0	0 $\frac{1}{2}$	0	0	0	0	0	0	0	0	0	0
Riser, a b.	211 214	210 211	214 210	211 211	210 210	210 209	210	210 210	210 207	200 210	210 211	211 212	209 210
Riser, A.	193 192	192 192	195 192	193 192	192 192	190 196	196	191 192	188 190	188 192	192 192	192 193	188 191
Riser, B.	183 186	179 188	184 182	182 188	183 186	180 190	188	179 190	178 184	173 186	184 182	182 184	180 184
Return, a b.	191 186	176 185	205 198	199 191	142 175	201 160	170	109 100	105 158	113 171	105 114	105 151	118 109
Riser, c d.	212 215	211 212	215 212	212 214	210 212	210 210	214 212	109 211	210 205	103 210	174 214	211 212	152 210
Riser, C.	195 202	197 200	200 198	196 200	196 198	194 199	197 200	115 196	102 180	64 198	113 198	194 195	132 198
Riser, D.	192 195	191 192	192 188	191 192	191 190	191 191	192 196	86 194	83 179	70 192	76 192	190 191	120 190
Return, c d.	153 92	133 167	to 170	170 170	98 155	118 153	150 160	109 70	106 142	109 141	90 96	60 120	133 80
Riser, f.	121 128	157 172	122 170	123 135	144 143	162 141	150 152	139 160	120 151	172 133	140 170	154 99	132 141
Riser, E.	110 112	140 152	105 155	108 128	130 140	146 130	136 146	126 150	118 141	153 122	129 152	132 89	112 122
Riser, F.	113 108	121 136	90 150	94 102	114 128	127 112	120 134	112 130	105 124	134 109	110 132	110 79	109 106
Upper return, f.	105 98	122 131	92 110	92 110	115 123	129 110	121 120	114 130	107 105	133 105	113 135	109 83	106 107
Lower return, f.	95 86	110 120	81 102	82 98	104 116	118 100	110 114	106 120	99 104	121 96	104 126	98 75	95 96
Outside temp.	26 18	14 14	14 12	16 30	34 33	38 40	36 42	36 30	34 38	34 40	40 36	17 27	32 32
House tempera- ture A.	67 56	68 55	66 58	67 62	70 62	62 70	68 65	64 62	62 44	62 48	64 72	59 61	53 56
House tempera- ture B.	68 55	46 59	56 52	63 66	71 64	58 72	62 66	48 72	38 66	39 62	74 60	64 65	58 58
House tempera- ture C.	66 60	79 58	74 60	73 66	66 64	65 70	70 68	70 60	64 70	63 65	71 64	58 60	63 58
House tempera- ture D.	65 64	64 58	64 60	64 65	65 60	63 68	69 65	63 66	58 66	66 64	68 64	57 61	62 58
House tempera- ture F.	64 60	65 60	63 64	56 61	68 62	68 66	76 66	68 70	65 65	74 64	70 72	61 55	65 62

Pipe Readings.

Air Readings.

SUMMARY OF TABLE I.

Steam.	Riser, a b.....	Average for the whole time,				211°
	Riser A.....	"	"	"	"	193°
	B.....	"	"	"	"	183°+
	Return a b.....	"	"	"	"	160°
	Riser c d.....	"	"	"	"	(208) 212°
	C.....	"	"	"	"	(191) 196°+
	D.....	"	"	"	"	(185) 192°
	Return c d.....	"	"	"	"	(131) 130°
Hot water.	Riser, f.....	"	"	"	"	155°+
	E.....	"	"	"	"	137°
	F.....	"	"	"	"	124°
	Upper return, f.....	"	"	"	"	122°
	Lower " f.....	"	"	"	"	111°

These figures show that the average temperature of the steam pipes, during six weeks of mid-winter, was much higher than that of hot-water pipes. We must now endeavor to ascertain how much of this greater heat was efficient in heating the houses, how it was related to the practical care and management of the establishment, and how much it cost.

2. *Radiation from the pipes.*—It is necessary at the outset to find out how much of the interior heat in the pipes—in both systems—passes into the atmosphere of the houses as warmth. This is done by a study of outside and inside pipe temperatures, after the method already explained. The methods of obtaining the outside pipe temperatures are necessarily somewhat questionable. If the thermometer bulbs were simply placed against the pipes without being covered, the readings would be very much subject to fluctuation from the effect of air temperatures, and they are doubtless somewhat so by the present method. It is probable, however, that on the whole they give a reasonably fair measure of the heat given off at those points. In order to determine as nearly as possible the relation between the inside temperatures and those obtained on the outside, a thermometer was placed on the outside, at the point where riser thermometer c d was inserted in the pipe, and two on the hot water riser near the point where riser thermometer f was inserted. All the steam risers are painted, while those carrying hot water are not; in order to obtain uniform results, a portion of the hot water pipe here was painted two coats, and one thermometer was placed on this, the other on the unpainted surface.

The average difference between inside and outside tempera-

tures in the steam riser at times when there was a free circulation was about 22° , with an inside temperature of about 214° . The average difference in the hot water pipe where painted was $5.9-14$ degrees, unpainted $4\frac{1}{2}$ degrees, with an inside temperature in each case of nearly 122° . This indicates that painted pipes radiate slightly less heat than unpainted ones. The great difference between the steam and hot water pipes is probably due to the higher temperature and more rapid motion of the steam. Consecutive observations on the steam riser made at a time when the steam was going down gave the following comparisons:

Inside temperature...	147°	130°	120°	110°	100°	90°
Outside " ...	137	122	114	106	98	89

These figures show that the greater the pressure—or the inside temperature—the greater is the proportionate difference between outside and inside temperatures. The outside temperature may be taken as the radiating or warming power of the pipe, and whatever difference there may be between the outside and the inside, represents the amount of heat which is carried further on. This greater difference under increasing pressure is due, apparently, to the more rapid circulation of the steam at such pressure by which proportionally less is given off at any one point, it being distributed over a greater length of pipe. This rapid movement is therefore an important advantage which steam possesses over hot water for heating long houses.

The very few other observations obtained on the steam riser at low temperatures indicate that this relation between outside and inside temperatures is reasonably uniform. The range of inside temperatures from which comparisons were obtained in the hot water pipes was much more limited, but there does not seem to be such a uniform difference between outside and inside readings with increase of temperature as with the steam. The results in Table I. plainly show a considerable variation at different points between the outside and inside temperatures, but how much of this is due to differences in painting, radiating powers of the pipes, etc., and how much to the crudeness of the method, it is impossible to say. Thermometer riser A shows a temperature differing not more than 18° , on the average, from that of the inside of the pipe; that on riser C shows 16° variation from the inside temperature, but as there was a distance of some 20 ft. between this and

twin inside thermometer c d, the real difference is probably more than 15 degrees.

It is evident, from this study of radiation, that the higher the inside temperature the less is the proportionate warming power of the pipe at a given point; and as a higher temperature and more rapid flow are ordinarily carried with steam than with hot water, steam has the advantage in carrying long runs. It is said, however, that much of the fierce heat of rapidly moving steam is returned to the heater and is lost as a direct warming agent; but this depends entirely upon the length of the run. It is to be expected that the relative merits of steam and hot water for greenhouse heating depend very much upon the sizes and shapes of the houses, and it is surprising that these conditions are so little considered. The distribution of heat in our two systems should now be discussed, for it will throw much light upon the whole question.

3. *Distribution of heat in the pipes.*—We will now compare the temperatures at extreme ends of the different systems, both in risers and returns, in order to determine where the heat is transferred to the atmosphere of the houses. Table II. shows the average temperatures, during the whole time, inside the risers and returns, and on the outside of the risers, at opposite ends of the houses. The inside thermometers in all the risers, and in the returns from the steam houses, were about 12 ft. from the heater; those in the hot water returns were some 20 or 25 ft. from the heater.

TABLE II.—AVERAGE PIPE TEMPERATURES.

Riser a b—Average inside temperature.....	211°
“ A— “ outside “	193°
“ B— “ “ “	183°+
Return a b—Average inside “	160°+
Riser c d—Average inside temperature.....	212°
“ C— “ outside “	196°+
“ D— “ “ “	192°—
Return c d—Average inside “	131°
Riser f—Average inside temperature.....	155°+
“ E— “ outside “	137°
“ F— “ “ “	124°+
Upper return f—Average inside temperature...	122°
Lower “ f— “ “ “	111°

By a comparison of these averages it is seen that the loss of heat in passing the whole length—some 60 feet—of the steam series A B averages 10 degrees, and owing to the fact that the thermometer at the farther end showed an error, the difference is probably even less than this. Frequently when there was steam pressure of three or four pounds the entire circuit of about 150 feet was made with a loss of only 10 or 11 degrees. The average loss between the opposite ends of series C and D—which is a warmer run—was only slightly more than 4 degrees. Allowing 15° to 18° for the difference between outside and inside measurements at the last end, it is seen that in the returns there is an average loss of about 40 degrees between the farther extremity of the house and the heater, although this difference is not at all uniform.

In the tomato and cucumber houses, C and D, heated by steam, the figures used, as before stated, are those obtained by disregarding the observations on the mornings of Feb. 23, 24, 25, 26 and 29, when there was practically no circulation in this run of pipes. Here the average difference between the registering of the ther-

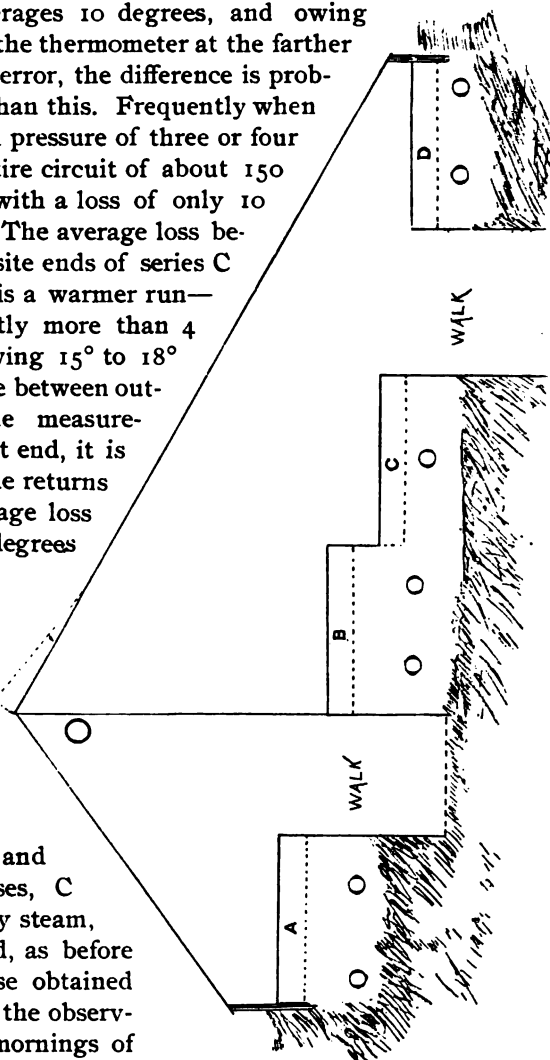


FIG. 2.—Cross-Section of House D. Scale one-fourth inch to the foot.

mometers inserted in the riser, and the first one outside, is only 16 degrees, although a distance of some 20 ft. or more is passed over between them. The average loss shown in the riser in passing the length of the two houses is only a trifle over four degrees, while in the return to the heater it averages some 75 degrees. This loss is much greater in proportion to the number of square feet of radiating surface in the returns than in the risers, yet it can hardly be said that the returns are more efficient in radiating heat. The greater loss in the returns of C and D than in those of A and B is approximately proportional to the number of square feet of radiating surface in the returns of C and D, as those of A and B condense into a single pipe, into which the thermometer was placed. This may indicate that the heat lost in the returns is radiated from the pipes in proportion to the surface, although it is impossible to say that this is the fact.

In the hot water house we find that the water leaves the heater at an average temperature of 155° and comes back at a temperature of 122° by the upper return and 111° by the lower return. There is an average loss of 13 degrees in passing the length of the house. If we assume that 5 degrees is a fair average for the difference of outside and inside temperatures at the west end and four degrees at the east end, it indicates a loss of 13 degrees from heater to the first end of the house—nearly 20 feet—13 degrees in passing the length of the house, 60 feet, 6 in the upper return and 17 in the lower return.

It is seen that in the steam plant the heat is nearly uniform throughout the whole length of the riser, being carried to the farther extremity of the houses with a loss of 4 to 10 degrees, while the hot water riser loses about 25 degrees in passing to the farther end, although on account of its location this point is some 20 ft. farther from the heater than the end of the steam house, C & D. In the hot water plant the variation in temperature between the point of leaving and the return to the heater is much less than with steam, but Table I shows far more irregularity in the comparative temperatures at different points, while as a rule more is lost in the riser than in the return. This shows plainly the superiority of steam for long distance heating and for purposes of bottom heat. The heat can be forced the whole length of the riser with comparatively little loss and be distributed

throughout the returns to be given off where it is most needed ; and the steam gives us a greater uniformity of temperature throughout the houses, as is well shown in Table III.

The following table shows the extreme variations in the difference of temperature at the opposite ends of the houses at any one time, disregarding the mornings before mentioned ; also the extreme fluctuation at each point, during the whole time :

TABLE III.—FLUCTUATION.

Fluctuation in difference between thermometers riser E and F. 12 less to 22 more, or 34° (Av. difference 13°).

Fluctuation in difference between risers C and D. 1 to 10, or 9° . (Av. difference 4°).

Fluctuation in difference between risers A and B. 2 to 15, or 13° . (Av. difference 10°).

Fluctuation in riser A, during test.....	189 to 203 or 14°
“ “ without pressure....	189 to 195 or 6°
“ “ B, during test.....	180 to 192 or 12°
“ “ C, “	180 to 205 or 25°
“ “ D, “	179 to 202 or 23°
“ “ E, “	105 to 180 or 75°
“ “ F, “	79 to 164 or 85°

It is seen that while the riser at the west end of the hot water house, E, averaged 13 degrees higher than the one at the east end, F, it was in one case 12 degrees lower and the extreme difference in the opposite direction was 22 degrees, or a fluctuation of 34 degrees, while that between opposite ends of the steam houses is much less, being only 4° in the warm houses, C and D. Another surprising point is the great variation in temperature at a given point in the hot water riser, averaging over four times as great as that of steam. Of course the steam temperatures, if taken in the middle of sunny days, or at any time when there was little or no circulation, would show a greater diversity than this, but it is to be borne in mind that these are just the times when the houses are warm enough and no heat is needed from the pipes. The general observations show that the times when temperatures were lowest in the hot water pipes were not warm mornings when the fires were low, but cold ones when the steam pipes showed high temperatures and all the heat was needed. In all points, therefore, steam surpassed hot water.

4. *Coal consumption.* January 20th at one o'clock P. M. both

heaters were shaken down as usual leaving only a thin bed of fire in the box. All the coal used during the next two weeks was weighed. Table IV shows the outdoor temperature and that of the different houses, together with the averages during that time :

TABLE IV. TEMPERATURES DURING COAL TEST.
JANUARY.

	20	21	22	23	24	25
Time	5:30	8:15	5:30	8:30	5:00	8:20
Outdoor Temp.....	3	13	21	26	32	34
House " A.....	64	62	59	60	64	70
" " B.....	65	64	56	57	63	72
" " C.....	68	66	68	63	71	69
" " D.....	61	61	61	58	60	68
" " F.....	68	65	68	58	67	76

JANUARY.

	26	27	28	29	30	31
Time	8:30	5:15	8:35	5:20	8:20	5:30
Outdoor Temp.....	0	6	8	15	20	30
House T. A.....	52	51	56	62	67	71
" " B.....	48	52	59	68	66	75
" " C.....	59	60	68	64	66	73
" " D.....	56	56	59	61	61	68
" " F.....	60	70	68	62	64	76

FEBRUARY.

	1	2	3	Av.
Time	8:30	5:20	8:30	5:20
Outdoor Temp.....	34	37	38	42
House " A.....	64	68	67	72
" " B.....	68	68	48	68
" " C.....	66	73	65	70
" " D.....	65	68	65	66
" " F.....	66	70	69	70

65 for steam.

67 for hot water.

The steam boiler consumed during this time 6,691 lbs. of coal, and the hot water boiler 5,251 lbs. The steam boiler heats about 2,500 square feet of surface. The hot water boiler heats about 1,700 sq. ft. The following comparisons are therefore obtained :

In surface heated,

Hot water : Steam :: 1 : 1.47—

In coal used,

Hot water : Steam :: 1 : 1.27—

This shows a consumption of about 15 per cent. more coal per 100 sq. ft. of surface heated by the hot water heater than by the steam heater. The average temperature is slightly higher in the hot water house than in the steam houses, but it was also more variable. In the colder parts of the night it went much lower, for twice during the winter plants were chilled in this house, while nothing of the kind occurred in the steam houses. As a matter of fact it has been difficult to maintain a suitable temperature in the hot water house whenever the weather was cold. These fluctuations in greenhouses are seldom indicated by observations taken at two or three stated intervals during the day. The space heated by the hot water causes considerable bending in the pipes, while the fall is rather slight, conditions which are unfavorable to water heating ; for every curve and angle interferes greatly with the movement of water. The results indicate that while hot water may equal steam in simple and straight runs, it is not so well adapted to use under varying and unfavorable circumstances and in long houses. No definite conclusion as to the relative merits of the two systems as to coal consumption can be made from these observations, for the conditions are not such as to give a genuine comparison. But they are an indication that steam is more economical under the conditions here present ; and our conditions are similar to those of most commercial forcing establishments.

It is impossible to determine whether this saving of coal in our steam plant is due to greater economy of steam as compared with hot water, or to mechanical differences in the two heaters. Fowler* considers steam cheaper than hot water in coal consumption, chiefly because excess of heat is shut off in the steam pipes, and steam heaters are commonly provided with automatic regulators. Our steam heater has an automatic regulator, while the hot water has not.

5. *Influence of pressure upon the temperature of steam pipes.*—While it is true that the greater the pressure indicated by the steam gauge, the more readily is the steam carried through long runs and past obstacles, the influence of this pressure upon the temperature of the pipes is not so obvious. Table V shows the influence of pressure upon the temperature of risers and returns :

*Hints on the Heating of Greenhouses, 31.

TABLE V.—STEAM PRESSURE AND PIPE TEMPERATURE.

JANUARY.

	20.	23.	24.		25.	26.		27.	28.	
Time.....	5:30	5:20	10:30	5.	5:15	8:30	5:15	5:20	8:30	5:20
Steam pressure.....	3 lbs.	1½	⅓	½	½	2¾	5½	4½	1	2
Riser A & B....	217	211	212	211	212	217	222	220	213	214
Return A & B.	209	195	201	202	105	207	211	210	198	195
Riser C & D....	218	213	212	212	212	218	224	221	214	214
Return C & D.	162	137	159	166	175	181	182	167	178	158

FEBRUARY.

	2.	3.	6.	11.	12.	13.	15.	17.	26.	Av. without pressure.	General av. for whole time.	
Time.....	5:30	5:20	5:30	7:45	8:30	8.	8:30	5.	8:30	10.	8:30	5.
Steam pressure	3lbs.	1½	2¾	2	1½	3	5	2	½	2	½	1
Riser A & B....	218	214	218	215	205	215	223	212	211	214	214	211
Return A & B.	206	200	204	200	166	207	212	185	191	186	205	114
Riser C & D....	218	214+	218	215	208	216	225	215	212	215	215	214
Return C & D.					119 to	162 to				165 to		
C & D..	150	152	162	176	128	145	171	90	153	92	175	96

A corresponding rise in temperature with increased pressure is shown, but it is not altogether uniform. It appears that the same temperature does not necessarily follow from the same pressure. The following figures, deduced from the results, furnish a rough estimate of the influence of pressure on the temperature inside the risers at this distance, about 12 ft. from the boiler :

1 lb. of pressure increases the temperature.....	1-3°
2 lbs. of " " " " "	3-4°
3 " " " " "	5-8°
5 " " " " "	12-14°

It is to be noted that in general, pressure increases the temperature of the returns much more than of the risers. The return from A and B in nearly every case of pressure shows a temperature higher than its general average at that point, while the exceptions are but few in the return from C and D. The return from A and B is direct, uniting but two of the runs of these houses, while that from houses C and D is from a slightly longer circuit, and unites all the runs, so that doubtless more of the steam is condensed in this latter case before reaching the point where the thermometer is inserted. Its lower general average indicates this.

These figures give conclusive evidence of the utility of pressure in forcing circulation through long circuits. They also suggest a question as to the economy of maintaining such a pressure as to keep up a rapid circulation. It is evident that the condensation of the steam in the returns liberates its latent heat where it must be available in warming the houses. Whether this makes a better use of the heat than to return the steam to the boiler uncondensed, allowing it to be again sent into the circuit without the expenditure of fuel necessary to the production of this latent heat, may be a question. The general observations show that there is usually a higher house temperature with steam pressure, when the outdoor temperature is about the same. It does not appear at all uniform, however, and the observations are not such as to give any satisfactory indications toward an answer to the question.

II. EXPERIMENTS ELSEWHERE.

It appears from the literature readily available, that the use of steam in closed circuits was invented by Mr. Hague in England about 1820*, although certain methods in which the steam passed off at the further end of the house, had been previously in use. At this time the construction of apparatus was such as to require almost constant attention to fires, in order to maintain the temperature. Frequent repairs were needed and explosions were common. The first trials with hot water were made by Anthony

* Trans. Lon. Hort. Soc. iv. p. 434.

Bacon and Mr. Atkinson in 1822.* These men worked independently, and both secured successful results.

The laws governing the circulation of hot water are carefully treated by Thomas Tredgold in a paper before the London Horticultural Society in 1828.† In 1840, John Rogers wrote, "On the whole there appears no doubt that the circulation of hot water in iron pipes is the best means hitherto devised for heating Horticultural Buildings."‡ This quotation probably represents about the consensus of opinion on the subject in England to the present day. One of the earlier promoters of this system was Charles Hood, author of "A Practical Treatise on Warming Buildings by Hot Water, and an Inquiry into the Laws of Radiant and Conducted Heat."

The use of steam for heating purposes began to receive marked attention in this country some fifteen years ago. In the discussions of the Society of American Florists in 1885, the average from estimates in answer to circulars by nearly fifty florists showed that one ton of coal with hot water heated 108 sq. ft. of glass to a temperature of $53\frac{1}{3}$ degrees, while with steam the same amount heated 149 sq. ft. to a temperature of $60\frac{3}{4}$ degrees. The proceedings of the society for 1886 contain two articles setting forth the advantages of steam and hot water respectively. The statements are based on individual opinion rather than on any comparative results. In the proceedings of the society for 1888 (Vol. iv. 118), James D. Raynolds gives a good comparison of the two methods from theoretical standpoints, his opinion being that steam is preferable.

So far as can be learned, the first really comparative test was made by Peter Henderson about 1885 or 1886.|| The trial was made with two houses of similar dimensions and construction, the one fitted with hot water boilers, the other with steam boilers of the same size. The coal was weighed and it was found that there was a saving of 25 per cent. in the house heated by steam, while the plants did equally well. A. B. Fowler, in a recent

* Trans. Lon. Hort. Soc. vii. 204.

† Trans. Lon. Hort. Soc. vii. 568.

‡ Trans. Lon. Hort. Soc. 2d series, ii. 364.

|| Proc. Soc. Am. Florists, Vol. ii. 107.

pamphlet on greenhouse heating, concludes that steam is preferable to hot water.

In the summer of 1888 two houses were constructed at the Massachusetts Experiment Station as nearly alike as possible, with boilers of the same make and pattern, one fitted for steam, the other for hot water. The following winter careful observations were made of temperatures and the amount of coal consumed. The results showed a saving of nearly 20 per cent. of coal in favor of the hot water heating, while the average temperature of the house was slightly higher. The temperature was also more uniform in the house heated by hot water. The test was repeated the following winter and showed a still greater advantage in favor of the hot water, there being a saving of over 30 per cent. in the coal consumed.

In the winter of 1889-90, a similar test was made at the Michigan Experiment Station with two houses of the same size and construction, and two boilers of the same make, having the same amount of grate and heating surface, and all other conditions as nearly alike as possible. The results agree with those in Massachusetts, showing a consumption of a little over 20 per cent. more coal by the steam boiler and a slightly higher temperature in the hot water house. These results are probably due to the simple and straight runs in these specially constructed houses.

The following is a list of references to the more important literature which bears on this subject. In general it includes only matter which deals with a comparison of the merits of the two methods:

1. Upon the Application of Hot Water in Heating Hot Houses—Thomas Tredgold, 1828. Trans. Lon. Hort. Soc. vii. 568.
2. Steam or Hot Water—James D. Raynolds. Amer. Florist, i. 46.
3. Steam vs. Hot Water—Alfred E. Whittle. Amer. Florist, i. 76.
4. Heating Greenhouses—Jos. H. Woodford. Amer. Florist, i. 235.
5. Hot Water Circulation—James D. Raynolds. Amer. Florist, iii. 62.
6. Steam Heating—W. H. Elliott. Amer. Florist, iii. 400.

7. The Heating of Greenhouses—E. S. Titus. *Amer. Florist*, iv. 223.
8. Steam Versus Hot Water for Heating—John Burton. *Amer. Florist*, v. 139.
9. Steam Versus Hot Water for Heating Greenhouses—John Thorpe. *Proc. Soc. Amer. Florists*, i. 56.
10. The Advantages of Hot Water over Steam for Heating Purposes—J. D. Carmody. *Proc. Soc. Amer. Florists*, ii. 107.
11. The Advantages of Steam over Hot Water—J. H. Taylor. *Proc. Soc. Am. Florists*, ii. 110.
12. Modes of Heating : Their Relative Cost of Construction and Operation—James D. Raynolds. *Proc. Soc. of Am. Florists*, iv. 118.
13. Bau und Einrichtung der Gerwächshäuser—Carl David Bouché and Julius Bouché, p. 304.
14. Greenhouse Building and Heating—L. R. Taft. *Bulletin* 63, Michigan Experiment Station.
15. Hot Water vs. Steam—Samuel T. Maynard. *Massachusetts Hatch Experiment Station, Bulletins* 4, 6 and 8.
16. Hints on the Heating of Greenhouses. Hot Water Heating. Low Pressure Steam Heating—A. B. Fowler. (Recent : no date).

CONCLUSIONS.

The results obtained lead to the following conclusions which are true under these conditions, although some of them may not be true universally :

1. The temperatures of steam pipes averaged higher than those of hot water pipes, throughout the entire circuit for the entire period of test.
2. The higher the inside temperature in steam pipes the less is the proportionate warming power of the pipes at a given point. The heat is distributed over a greater length of pipe, and as steam is ordinarily carried at a higher temperature than hot water, it has a distinct advantage for heating long runs.
3. When no pressure is indicated by the steam gauge, the difference between the temperatures of the riser and the return, is greater with steam than with hot water.

4. Under pressure, the difference is less with steam than with hot water.

5. There is less loss of heat in the steam risers than in the hot water risers, and this means that more heat, in the steam system, is carried to the farther end of the house and more is spent in the returns as bottom heat.

6. This relation is more uniform in the steam risers than in the hot water risers, giving much more even results with steam than with hot water.

7. When the fires are operative, the fluctuation in the temperature of the risers at any given point is much greater with hot water than with steam.

8. An increase in steam pressure raises the temperature of the entire circuit, but the temperature does not rise uniformly with the pressure.

9. The first application of the pressure increases the temperature of the returns much more than that of the risers.

10. Steam is better than hot water for long and crooked circuits.

11. Pressure is of great utility in increasing the rapidity of circulation of steam, and in forcing it through long circuits and over obstacles.

12. Unfavorable conditions can be more readily overcome with steam than with hot water.

13. Hot water consumed more coal than steam, and was at the same time less efficient. This result would probably be modified in a shorter and straighter circuit, with greater fall.

14. Under the conditions here present, steam is more economical than hot water and more satisfactory in every way ; and this result is not modified to any extent by the style of heaters used.

FRED W. CARD.

Bulletin 42.

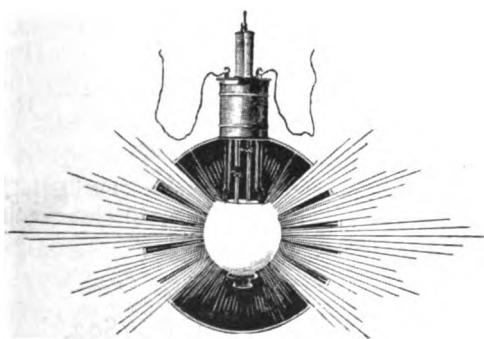
September, 1892.

Cornell University Agricultural Experiment Station.

HORTICULTURAL DIVISION.

SECOND REPORT UPON

Electro-Horticulture.



By L. H. BAILEY.

PUBLISHED BY THE UNIVERSITY,

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BULLETINS OF 1892.

38. The Cultivated Native Plums and Cherries.
39. Creaming and Aerating Milk.
40. Removing Tassels from Corn.
41. On the Comparative Merits of Steam and Hot Water for Greenhouse Heating.
42. Second Report upon Electro-Horticulture.

SECOND REPORT UPON ELECTRO-HORTI- CULTURE.

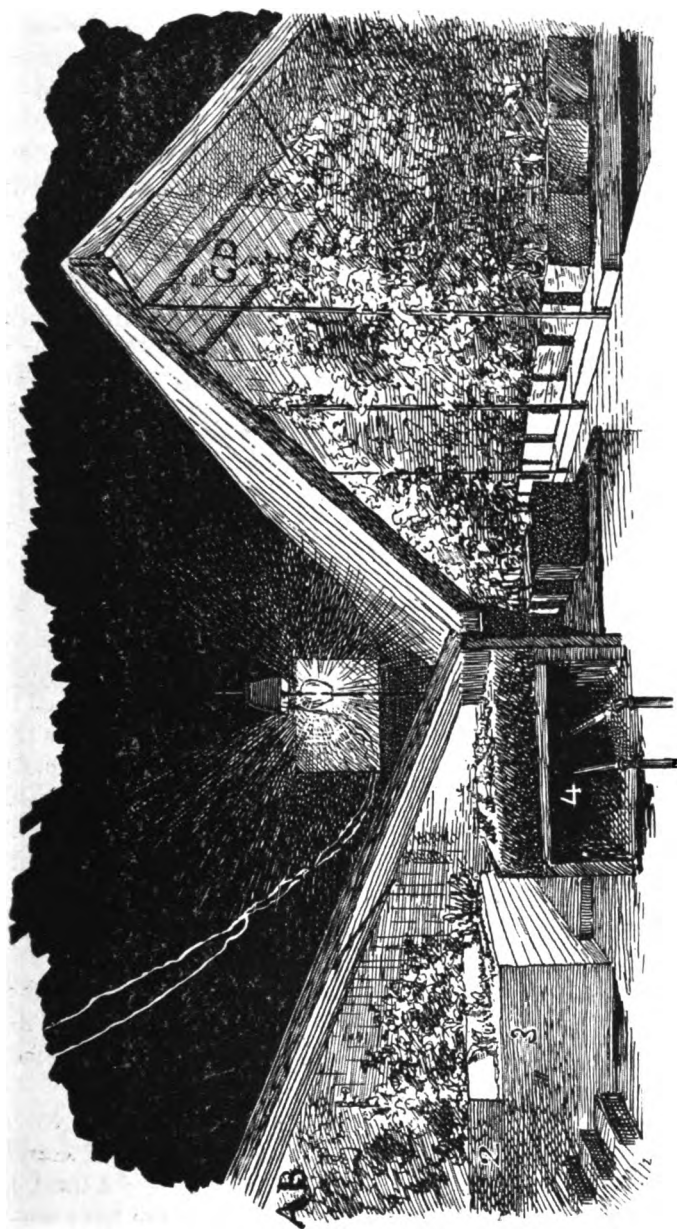
Beginning with the opening of the year 1890, a series of experiments was inaugurated upon some of the relations of electric lighting to plants grown in glass houses, and the results of the experiments for two winters were published a year ago (Bulletin 30). It was found that the electric light profoundly affects many plants, some injuriously and a few beneficially. Lettuce appeared to be greatly assisted by the light, and some ornamental plants produced earlier and brighter flowers under its influence. The experiments were all made with an arc lamp which hung inside the house, and it was found that better results were obtained when the arc was screened by an opal globe or even by a pane of window glass. The question at once arose if this screen could not be afforded with equal advantage by the glass roof itself if the light were hung above it; and if this were true, it must then be determined how far the beneficial effects of the light would extend, or, in other words, how much glass one light can cover. It is this particular point which the following paper considers. It may be said, in passing, that several other important investigations are in progress, but we are not yet ready to report upon them. Perhaps the most important of these investigations is one in which the light is passed through colored screens of known value, in order to determine what parts of the spectrum produce the singular results which we have observed.

We shall now consider, therefore, what are the effects upon a few common plants of an electric street-lamp suspended above a greenhouse. The arrangement of the experiment will be understood at a glance from the cross-section of the houses under discussion, on page 135. It will be noticed that there are two parallel houses; each is divided in the middle into two com-

partments. These houses are 60x20 feet. In the valley between these houses the lamp was hung, and the arc was six feet above the nearest glass. The lamp was hung in front of a large, blackened sheet-iron screen, which, in connection with the partition in the house and a series of curtains, completely excluded the light from the compartment behind the lamp. By moving the screen to the other side of the lamp and rearranging the curtains, we were able to throw all the light into the other compartment; this change was made during the experiment. The lamp is the same pattern as that used the previous winter,—a 10 ampere 45 volt 2000 nominal candle power Westinghouse alternating current lamp. The lamp was attached to an ordinary street lighting system, and it seldom burned after 11 o'clock, while it often ran but an hour or two, and on moonlight nights not at all. The lighted house was exposed to sunlight during the day, and in addition received this small and varying amount of electric light. The other or so-called dark house was lighted by sun during the day and received no light at night. The lamp carried a clear glass globe, so that the light passed through two planes of glass—the globe and the roof—before reaching the plants.

The upper house—comprising the compartments A and B—is what we term a cool house, and it was used for lettuce, endive, radishes, beets, spinage, cauliflower, violets and daisies. This is the house in which the experiments were mostly conducted, from the fact that the two compartments of the other house have unlike roofs and are therefore not comparable. These houses A B are the ones which were used in the experiments reported last year. Lettuce was grown on benches 1, 3 and 4; radishes upon the same, mostly between lettuce plants; beets upon 2; cauliflowers upon 3; and the other plants upon 2. Bench No. 1 is not shown in the illustration. The lower houses C D were used for tomatoes, cucumbers and beans; and as I shall not refer to those houses again, it may here be said that I was unable to detect any influence whatever of the light upon these three plants.

Lettuce.—Our main crop was lettuce, for in previous experiments we had found a decidedly beneficial influence of the light upon it. This benefit was fully as apparent this year. There



Cross-Section of the electric light houses.

can no longer be any doubt as to the advantage of the electric light in the forcing of lettuce. The light was started October 19th, 1891. At that time, Boston Market lettuce four weeks old was set on bench 4, and seedling plants of Landreth Forcing were just showing on bench 3. The transplanted plants (bench 4) in the light compartment soon began to excel those in the dark compartment, and as early as October 27th, or a week after the starting of the light, they were perceptibly ahead of the others. In this time 40 hours of electric light had been expended upon the plants. The plants directly under the light, from seven to ten feet from the arc, were the first to improve. November 1st, the lighted plants were a fourth larger than the others, and they showed a marked tendency to turn towards the light. The plants, even to the farther extremity of the light compartment, gained steadily throughout the experiment, and they were ready for market from a week to ten days earlier than in the dark house. In quality and all other characters, this lettuce was indistinguishable from that grown under normal conditions.

The lettuce on bench 3—which had been sown there—behaved differently. For the first week or ten days, the plants under the light were stunted, notwithstanding the fact that they were farther from the lamp than those on bench 4, which did so well from the first. After some days of lingering, when the plants began to acquire three or four leaves, these seedlings began rapidly to recuperate and they finally overtook their companions in the dark house; but these plants never showed the superiority which the transplanted ones on bench 4 exhibited. We were prepared for this behavior, for we had observed it before, and Dehérain has reported similar results with other plants in his experiments in Paris. The reason for this injury to very young plants I shall not now attempt to discuss; it is sufficient for our present purpose to say that it appears to be better to sow lettuce under common conditions, and when the plants are well established, to transplant them under the light.

Lettuce was also transplanted into the upper bench, No. 1, in order to determine how far the influence of the light extends. The extremity of the light compartment was 40 feet distant from the lamp, and the roof is so low that much of the light was re-

flected, yet at this distance, where there was only diffused light, the plants at a month after the light started were much better than in the dark house.

The experiment was repeated with second and third crops of lettuce with similar results, and with several varieties. February 9th, Simpson lettuce was transplanted upon bench 4, and the customary increase under the light took place. March 22d,



The Electric Light for Lettuce Growing.

when the lettuce was nearly large enough for market, the light was transferred to house B, and thereafter the poorer plants received the light. These poorer plants soon showed the effect of the new conditions, and the time between the maturity of the two crops was considerably lessened.

Perhaps the best illustration which we found of the influence of the light upon lettuce was afforded by a crop upon bench 1, into which radishes were also planted. The interception of the light by the radish leaves had a most marked effect upon the lettuce plants which stood behind them, the adjacent plants which chanced to be exposed to the full light being much larger. The bench therefore presented a very uneven appearance when the radishes were removed, and the shadows from the radish leaves

could be traced in the lettuce. Similar results were observed where the dense shade of a rafter lay across the plants.

In this connection, I wish to call attention to the fact that W. W. Rawson, at Arlington, near Boston, now uses the electric light in the commercial forcing of lettuce. Some of his methods are described by the present writer in the August number of *American Gardening*, from which the accompanying illustration (p. 137) is borrowed. The house shown in the cut is 33x370 feet, covering nearly one-third of an acre. Along the north side of this house are three 2000-candle power lamps which are run all night. Mr. Rawson calculates that he receives a gain of five days in a crop of lettuce by the use of these lamps, and as he grows three crops during the winter the total gain is over two weeks of time. The gain from one crop is estimated to pay the cost of running the lights all winter. The effect of the light is said to be marked at the distance of 100 feet.

Endive.—Plants of endive were transplanted into bench 2 November 11th, at the age of five weeks. The plants in the two compartments were much alike throughout the experiment, and it is impossible to say if the light exercised any beneficial influence, but it is certain that there was no injurious influence. In the 1890 test, under the naked light, inside the house, endive was injured, but other plants, which are known to be benefited by a modified light, also suffered under those conditions.

Radishes.—Radishes of various kinds were grown upon benches 1, 3 and 4, between young lettuce plants. The first crop—which alone is considered here—was sown a week before the light started, so that the plants were well up when the test began. Harvest was made December 3d, and in the meantime 229½ hours of electric light had been expended upon the plants, or an average of 5.1 hours per night. The following table gives the results of the radish test :

RADISH TEST.

SAMPLES.	1.		2.		3.		4.	
	Average wt. of entire plant.		Av. wt. of tops of marketable tubers.		Av. weight of tubers marketable.		Per cent. of marketable tubers.	
	Light house.	Dark house.	Light house.	Dark house.	Light house.	Dark house.	Light house.	Dark house.
Bench 4. { French Forcing (<i>Neu Forcing Early French Deep Scarlet</i>)	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Per ct.	Per ct.
	.229	.209	.158	.154	.138	.142	60.1	49.7
	.257	.232	.125	.114	.166	.179	78.2	66.6
	.236	.296	.162	.165	.177	.209	50.0	68.7
Bench 3. { Scarlet Globe	.173	.125	.125	.125	.125	.175	51.6	20.8
	.352	.329	.193	.162	.216	.227	77.2	76.7
	.327	.263	.150	.109	.200	.172	81.7	88.8
	.331	.328	.190	.221	.226	.206	55.7	58.0
Bench 1. { Deep Scarlet Turnip	.310	.184	.181	.067	.181	.053	66.6	70.0
	.299	.309	.167	.166	.176	.209	75.9	66.8
	.360	.478	.253	.250	.210	.270	70.0	80.4
	.284	.180	.127	.075	.190	.155	84.6	69.4
	.240	.163	.112	.082	.146	.109	89.7	68.2
Average	.299	.258	.162	.141	.179	.175	70.1	65.3
Average for bench 4.	.241	.246	.148	.144	.160	.177	62.7	61.6
" " " 3.	.295	.261	.164	.154	.192	.195	66.5	61.1
" " " 1.	.298	.263	.148	.130	.181	.159	77.3	70.9

It will be seen from the averages in the first part of the table that the plants in the light house were ahead in every feature. It will also be noticed that the proportion of tops (column 2) to the entire plant (column 1) is greater in the light than in the dark house, the difference being that between 55 per cent. and 49 per cent. All these results are interesting when compared with our former experience, for they show how much the simple interposition of plain glass may modify the influence of the light. In 1890, under the naked light, radishes were uniformly injured, the loss ranging from 45 to 65 per cent. ; the same year under a light protected by an opal globe, the injury was still apparent, but the loss in tubers was only from one to five per cent. of the crop, but at the same time the weight of leaves was increased ; now this year, under light strained through a globe and a glass roof, there was an increase in both tubers and tops.

It may now be asked at what distance from the lamp the best

results were obtained, for our radishes this year were grown on three parallel benches covering a distance of 20 feet. Unfortunately, I cannot answer this question, for different varieties were grown on the different benches and the benches are therefore not comparable. The averages for the different benches are given in the second part of the table, however, but the figures are so contradictory that little can be learned from them. As a rule, the best results, as shown by the figures, were obtained on the bench farthest from the light, but this may be due to variety. More reliable figures can be obtained from different parts of a bed under the light, one sash being chosen from directly under the light and one from 13 to 15 feet away and where only diffused light reached the plants. These figures are as follows, all pertaining to the same variety, the Scarlet Globe :

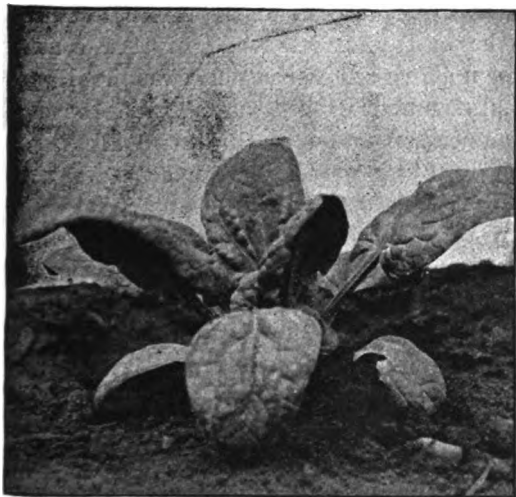
Sample.	Average weight of entire plant.	Average weight of top.	Average weight of tuber.	Per cent. of marketable tubers.
Directly under lamp.....	70 gr.	30 gr.	40 gr.	71
13 to 15 feet from lamp.....	66 gr.	32 gr.	34 gr.	65

Decidedly better results were obtained from the sash directly under the light, for not only were the tubers more and larger, but the tops were less.

In no case, however, have radishes been sufficiently benefited to pay the cost of the light ; but our results seem to show that a well protected light is some assistance to them.

Beets.—Four days before the light started, October 15th, seeds of Early Egyptian beet were sown in both compartments, on bench 2. A month later, after 160 hours of light had been expended upon them, the beets in the light compartment were at least one-third larger than those in the dark house. Five months after sowing, the beets were removed, when it was found that 57 per cent. of the plants in the light house gave marketable tubers, against only 33 per cent. of those in the dark house ; and the total average weight of the plants in the light was about half an ounce greater than in the dark house. It must be said, however,

that the test with beets was hardly a fair one from the fact that the plants in the dark house received more bottom heat than the others; but as the results corroborate those obtained from radishes, the figures may possess value.



Spinage grown in 1890. The low plant grew under normal conditions, the slender one under the naked electric light.

Spinage.—When the light was started, spinage was transplanted into bench 2 in both compartments. This spinage was Round Dutch, but it came from three different sources, in which the reader will be interested; and I hope that I may be pardoned for a short digression to discuss a matter concerning the variation of plants. It will be remembered that in our earlier experiments under the naked light spinage ran directly to seed, while plants in the dark house made good edible leaves. This difference is shown admirably in the accompanying figures, which are taken from our Bulletin 30. The slender plant was grown under the light in 1890 and it ran at once to seed; seeds from this identical plant were saved, and they were sown in plot No. 1 below. The low plant was grown in the dark house at the same time, and the seeds from it were sown in plot No. 2. Will the characters

which these plants assumed under our former experiment be perpetuated in the offspring? We shall see; and for comparison we shall use commercial seeds in plot No. 3.

Now, in the light-house, the best of these three plots was No. 2, the seeds which came from the low plant figured above; and the second best plot was No. 3, the commercial seed. In the dark house, however, the best plot was No. 1, or that coming from the poor plant shown above; the second best was plot No. 2. Thus it will be seen that commercial seed was always second or third; while No. 1 was once best and once third, and No. 2 was once best and once second. But it should be said that it was very difficult to distinguish between 1 and 2, while commercial seeds gave obviously poorer results. Two lessons are apparent from this test: 1. The characters of the parent plants were not hereditary; 2. Our own seed gave better results than commercial seed, and this was no doubt due to the fact that our seed, coming from single plants, had a less mixed or variable parentage than the other.

We shall now return to the influence of the light upon the spinage. A month after the light started, there having been an average of about 5 hours per night of electric light, all the spinage in the light house was from 10 to 15 per cent. larger than in the dark house and there was no greater disposition to run to seed; and this advantage was maintained, if not augmented, throughout the experiment. This result was unexpected, for in our first experiment spinage was very much injured by the light; but in that experiment the light was naked and was inside the house and the results are therefore not comparable with the present ones.

Cauliflower.—On January 8th, 1892, two dozen good cauliflower plants four inches high and bearing four or five leaves, were placed in 6-inch pots and divided between the two houses, on bench No. 2. The plants in the light house were ten feet from the lamp, and almost under it, so that they received the full glare of light. A month later, 93 hours of light having been expended, the plants in the dark house were noticeably stouter and more stocky than those in the light house, and two of the plants were forming heads, while those in the other house showed no sign of

heading. A week later, four good heads were growing in the dark house, one of them reaching a diameter of $3\frac{1}{2}$ inches, while none were visible in the light house. It was a week later that heads began to appear in the light house, or two weeks after they had been observed in the other plants; and at this time it was plain that the lighted plants were running to length, while the others were stocky. When the plants were cut, February 29th, the measurements were as follows:

SAMPLES.	Average total height of plant.	Av. length of stem below the leaves.	Average diam of heads formed.	Average weight of heads.
Dark house.....	18.4 in.	6.2 in.	5.4 in.	5.3 oz.
Light house.....	19.5 "	7.7 "	4.2 "	5.2 "

These figures show that decidedly better results were obtained in the dark house; and it should also be said that more heads were obtained in that house. These results are unequivocal, but the plants under experiment were so few that general conclusions cannot be drawn. It is expected that this experiment will be repeated upon a much larger scale the coming winter.

Flowers.—Violets and daisies were grown upon bench 2. In both instances, strong plants were set in the beds a few days before the light started. The violets (Marie Louise) were all set in the light house near the partition—12 to 16 feet from the lamp—and they received the full benefit of the light. Half of the bed of 100 plants was covered each night with a black enamel-cloth box, provision being made for ventilation, and the other half received the light. Three weeks after the light started the exposed plants began to bloom, while no buds could be found in the darkened portion. It was not until five weeks after the starting of the light that a flower appeared in the darkened plants, while the others had continued to bloom. At this point the obscure violet blight appeared and the experiment with the light ceased.

Fifty strong plants of the low daisy (*Bellis perennis*) were divided between the two houses. Those in the light compartment were from 15 to 18 feet from the lamp, in rather weak light. The

first bloom appeared just four weeks after the starting of the light, and it was in the light house. For a month or six weeks thereafter the lighted plants bloomed more profusely ; but at that time the dark house plants began to surpass the others, both in numbers and size of flowers and vigor of plants. In other words, the lighted plants bloomed earlier and never made such stocky plants, and they soon exhausted themselves. It is possible that they would have endured longer if they had been established in the beds for a longer period before the light was put upon them.

When do the plants grow?—It is thought that plants grow mostly at night, using the materials which they have manufactured during the hours of sunlight. The question then arises when the lighted plants grew. Did they grow more rapidly than the others during their fewer hours of darkness, or did they grow when the electric light was burning? We have made many tests with auxanometers—instruments which measure and record the periodical growth of the plants. The most important fact which these readings have shown is that lettuce plants, under normal conditions, grow about as much in daylight as in darkness ; and the periodicity of growth was very irregular. Lettuce leaves were found to grow more rapidly in the light house for the first week or so, at which time growth became greater in the dark house. That is, the leaves matured more quickly under the light. The accompanying records show this. These are the records of the growth of a single leaf upon a well established plant in each house during four consecutive days, the leaf in each case being an inch and a half long when the test was begun. The measurements are here recorded in sixty-fourths of an inch, only the numerators being used : thus 4 means 4-64 inch. The four hours during which the light ran are shown by asterisks in the third column, and whatever gain the lighted plants made over the others is shown by asterisks in the following column ; it is therefore apparent at a glance what relation such increase bears to the hours of the artificial lighting.

GROWTH OF LETTUCE.

April 1.				April 3.			
Hour.	Dark house	Light Asterisks show when light ran.	Gain. Asterisks show gain under light	Hour.	Dark house.	Light. Asterisks show when light ran.	Gain. Asterisks show gain under light.
11 A. M.	2½	4	*1½	11 A. M.		2	
12 M.	3	5½	*2½	12 M.		0	
1 P. M.	6	5	1	1 P. M.		½	
2	4	5½	*1½	2	Details of record too slight for accurate measurement.	2	
3	4	6	*2	3		6½	
4	3½	7	*3½	4		9	
5	3½	10	*6½	5		8	
6	3½	8	*4½	6		6	
7	4	*6½	*2½	7		*3½	
8	5	*7	*2	8		*4½	
9	6	*8½	*2½	9		*4½	
10	7½	*10	*2½	10		*3	
11	8	10	*2	11		4	
12	7	10½	*3½	12		4½	
1 A. M.	7½	10½	*3	1 A. M.		5	
2	7½	10	*2½	2		6	
3	8	10	*2	3		6½	
4	8	10½	*2½	4		6	
5	14	9	5	5		5	
6	5	9½	*4½	6		6	
7	8	12	*4	7		5½	
8	7	11½	*4½	8		1	
9	7	10	*3	9		2	
	139½	196½			26	101	

April 2.				April 4.			
Hour.	Dark house	Light Asterisks show when light ran.	Gain. Asterisks show gain under light	Hour.	Dark house.	Light. Asterisks show when light ran.	Gain. Asterisks show gain under light.
12 M.	7	8	*1	5 P. M.	9	9½	*½
1 P. M.	4	10	*6	6	7	6½	½
2	10	12½	*2½	7	5½	*5	4½
3	9	10	*1	8	4½	*5	*½
4	8	10	*2	9	4	*3	1
5	5½	4	1½	10	3½	*2¾	¾
6	4	4	0	11	3½	4	*½
7	4½	*9	*4½	12	3½	4	*½
8	6	*11	*5	1 A. M.	4	3½	½
9	7	*11	*4	2	4	4	0
10	7½	*11	*3½	3	3½	4	*½
11	7	8½	*1½	4	3	5	*2
12	5	8	*3	5	4	4	0
1 A. M.	5	7	*2	6	3	3½	*½
2	6½	9	*2½	7	1½	2	*½
3	7	9	*2				
4	7	9	*2		67½	65¾	
5	7	9	*2				
6	6	10	*4				
7	5	11	*6				
8	1	8	*7				
9	0	1	*1				
	129	190					

The figures plainly show : 1. That the electric light did not determine the periodicity of growth. 2. That increase under the light occurred only during the first days. 3. That growth in both houses took place in daylight as well as in darkness. The conclusions suggested by this short record, I believe to be generally true of lettuce, when grown under the conditions here present.

SUMMARY.

1. The influence of the electric arc light upon greenhouse plants is greatly modified by the use of a clear glass globe or the interposition of a glass roof. Plants which are much injured by a naked light, may be benefited by a protected light.

2. As a rule, plants are earlier under the electric light than when grown in ordinary conditions.

3. The light can be suspended above the house with good effect.

4. Lettuce is greatly benefited by the electric light. An average of five hours of light per night hastened maturity from a week to ten days, at the distance of ten and twelve feet. Even at 40 feet, in only diffused light, the effect was marked. The light appeared to injure young newly transplanted plants.

5. Radishes were also benefited by the light, but not to a great extent. When the light was hung in the house, however, whether naked or protected by a globe, radishes were injured.

6. Beets and spinage appeared to be slightly benefited by the light.

7. Cauliflowers under the light tended to grow taller than in ordinary conditions, and to make fewer and smaller heads.

8. Violets and daisies bloomed earlier in the light house. This corroborates results obtained with other flowers in our earlier experiment.

9. The electric light does not appear to determine or modify the hours of growth of lettuce and some other plants which have been studied in this particular. Plants which are benefited, simply grow more rapidly during the customary periods.

10. I am convinced that the electric light can be used to advantage in the forcing of some plants.

L. H. BAILEY.

Bulletin 43.

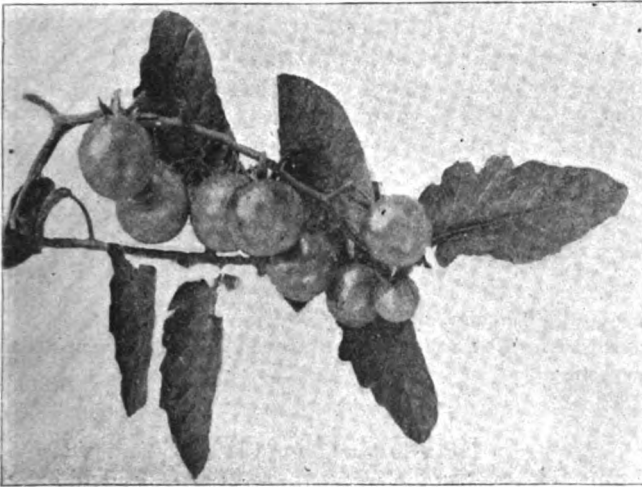
September, 1892.

Cornell University Agricultural Experiment Station.

HORTICULTURAL DIVISION.

SOME

Troubles of Winter Tomatoes



By L. H. BAILEY.

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SOME TROUBLES OF WINTER TOMATOES.

Nearly all forced plants are subject to many diseases and annoyances, arising from the fact that the enemies, as well as the hosts, are protected by the congenial and equable conditions of the glass house. As the cultivation of a given plant becomes more common and widespread, new enemies are likely to find it. The tomato is rapidly becoming an important winter crop, and its enemies are therefore coming into prominence. Two of these troubles—the winter blight and root-gall—are so obscure in their methods that growers often fail to recognize them until the crop is ruined ; and as they already appear to be widespread in the north, it has been thought best to call attention to them.

1. *Winter blight*.—The most serious disease of forced tomatoes which I have yet encountered is what, for lack of a better name, I propose to call the winter blight, and which is the chief concern of this paper. This disease, so far as I know, has not been described except in a short communication from this Station in *Garden and Forest* last April.* It has not yet been carefully studied in the laboratory, but various attempts have been made to check it ; and as it is likely to prove a serious disease, the attention of both growers and experimenters should be called to it. The object of the present report is to record the disease and to draw attention to it, rather than to present any full analysis of it. The disease first appeared in our houses in the winter of 1890-91, when about a dozen plants were somewhat affected. At this time the trouble was not regarded as specific ; the plants were old and had borne one crop, and it was thought that they were simply worn out. In some of our experiments it became necessary to

*A New Disease of the Tomato, by E. G. Lodeman. *Garden and Forest*, v. 175.

carry about a dozen plants over the summer, and these were introduced into the house when the forcing season opened last October. From this stock, the trouble again spread and in six or eight weeks it had become serious and there was no longer any doubt that we were contending with a specific disease.

This blight attacks the leaves. The first indication of the trouble is a dwarfing and slight fading of the leaves, and the appearance of more or less ill-defined yellowish spots or splashes. These spots soon become dark or almost black, and the leaf curls and becomes stiff, the edges drawing downward and giving the plant a wilted appearance. This condition of the leaf is well shown in Fig 1. The spots grow larger, until they often become an eighth of an inch across, or even more, and they are finally more or less translucent. This injury to the foliage causes the plant to dwindle, and the stems become small and hard. Fruit produc-

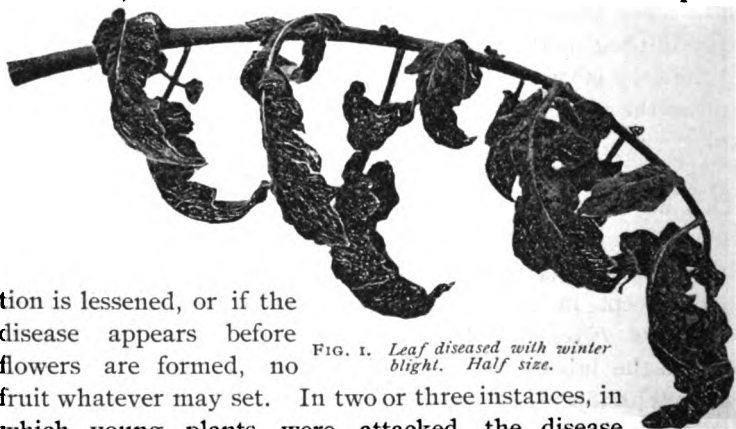


FIG. 1. *Leaf diseased with winter blight. Half size.*

tion is lessened, or if the disease appears before flowers are formed, no fruit whatever may set. In two or three instances, in which young plants were attacked, the disease killed the plant outright, but a diseased plant ordinarily lives throughout the winter, a constant disappointment to its owner, but always inspiring the vain hope that greater age or better care may overcome the difficulty. Fig. 2 is a graphic illustration of the appearance of the disease. The box contains four plants, one of which is healthy, and three diseased. The small plant in the rear died before it reached full stature. It is not known that this disease attacks the fruit. Fruit-rot appeared on some of the plants, but it was apparently the same as that which attacks out-door plantations.

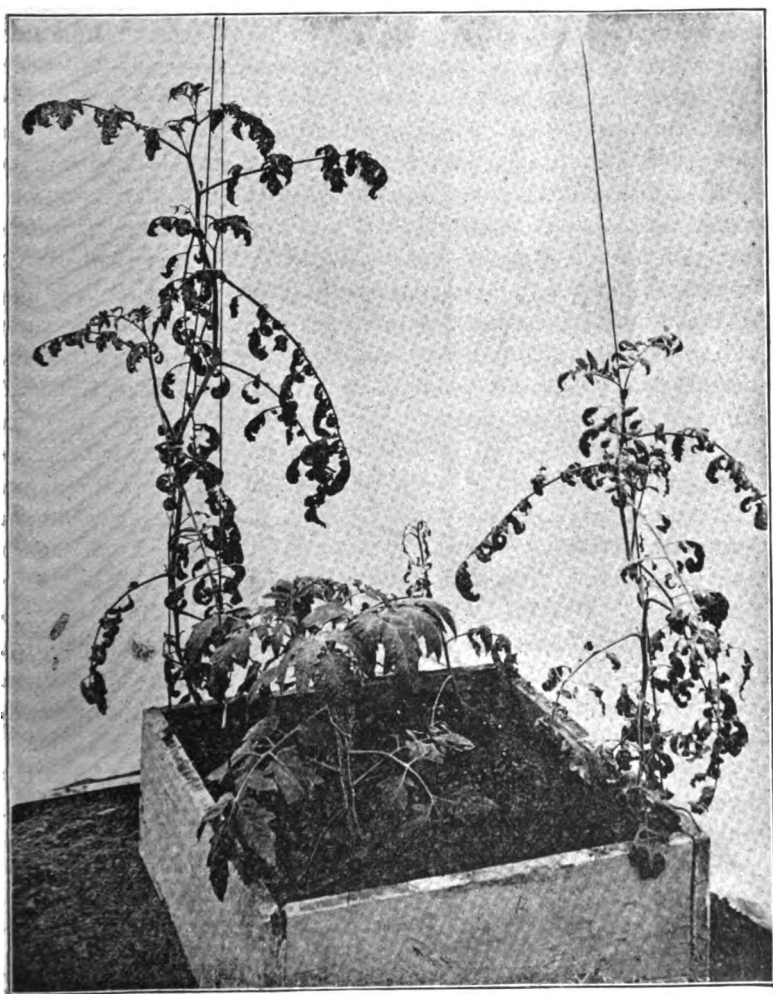


FIG. 2.—*The Winter Blight. A healthy plant in the front.*
(See pages 150 and 154.)

It soon appeared probable that the disease is bacterial in origin and it was at first thought that it is identical with the bacterial potato blight and that our plants had originally contracted the disease from soil taken from an infested potato field ; and this view was supported by the testimony of others who had been troubled with it and who had taken soil from potato plantations.* Specimens were submitted, however, to Dr. T. J. Burrill, of the University of Illinois, who replies that the trouble is probably not the same as the potato disease. A diseased tomato cion was grafted into a potato plant, and the stock for some inches below the union became diseased and finally died ; and this potato stock abounded in germs to all appearance like those infesting the cion, but inoculations from pure cultures were not made and it is not safe to say that the tomato disease can be transferred to the potato. Potatoes were planted in boxes containing diseased tomatoes and they did not contract the disease ; and a crop of potatoes was also grown on one of the benches in the tomato house, separated from the diseased tomatoes only by a three-foot walk, and it remained healthy. Tomato plants at this distance from affected plants invariably took the disease. It was then thought that the disease might be identical with the southern tomato blight described by Dr. B. D. Halsted in Bulletin 19 of the Mississippi Experiment Station. Specimens were sent him, when it was found that the two are distinct both in external appearance and in the character of the organism, the germ of the southern blight being a bacterium while this is a micrococcus.

All that is known further concerning the probable cause of the disease will appear in the following report from Professor W. R. Dudley, who has made some preliminary examinations of the diseased plants :

" I find a species of micrococcus present in limited numbers in the cells of the tomato leaves, both in those which were blanched, indicating the earlier stages of this disease, and in those blackened by its later development, and also in the diseased fruits. Moreover, the external aspect of this disease,—the blackening or

* In Horticulturists' Rule-Book, 2d ed. (p. 59), which was going through the press at this time, the statement is made that "the bacterial potato-blight or rot also attacks tomatoes." I do not know if this statement is true.

blighting of portions of the plants—is such as characterizes diseases occasioned by bacteria in other plants. Nevertheless, the preliminary cultures made did not give any results supporting this theory. Sterilized nutrient agar-agar* was infected with sap from the diseased tomato leaves and fruits with no result whatever; while similar infection from the stem of a potato infested with apparently a bacterial disease,† gave a cloudy-white growth along the track of the infecting wire and on the surface of the agar-agar which microscopical examination showed to be due to a minute micrococcus. Experiments necessary to the determination of this as a specific organism producing this particular tomato disease have not been made. Nor were other nutrient solutions used, which might have been more acceptable food for the micrococcus in a pure culture.

“I cannot feel sure that this disease was caused primarily by bacteria, which were certainly not present in great abundance. From microscopic examination of a considerable number of leaves from various sources, and observations in relation to this disease, on winter-grown tomatoes elsewhere, I think that no injurious effects of bacteria will appear, if houses are kept clean, properly heated and ventilated so that the vitality of the plants will not be impaired, and also if the houses are renovated at intervals.”

We are carrying diseased plants over the summer, and a critical study of the disease will probably be made the coming winter. We shall also be glad of any experience which others may have had with the trouble, and specimens of affected plants are desired.

Various treatments have been tried upon this disease. Our first attempt was thorough spraying with ammoniacal carbonate of copper, and this is the one which first suggests itself to growers. Our efforts, although carefully made at intervals, were wholly unsuccessful. It was then thought that treatment of the soil in which new plants were set might prove effective, and as

* Agar-agar is a gelatinous vegetable substance used for making cultures of bacteria.

† This potato stem had been grafted with a diseased tomato cion. See p. 152.

our crop was grown in boxes—as shown in Fig. 2—the experiment was easily tried.

Boxes in which diseased plants had grown were emptied and the insides were thoroughly washed with various substances, as follows: three with dilute solution of ammoniacal carbonate of copper; two with lime whitewash; one with Bordeaux mixture; two with lye. Fresh soil was placed in these boxes and healthy young plants were set in them. The boxes were then placed in the tomato house, near both healthy and diseased plants. For three or four weeks the plants appeared to be healthy, but after that time the disease attacked them all without respect to treatment. The same result followed thorough watering of the soil with ammoniacal carbonate of copper, nitrate of soda, and lye. Fig. 2 shows a box which was treated once with ammoniacal carbonate of copper applied to the soil. The plants were somewhat diseased when the treatment was given. The disease progressed without check. One plant died, and a healthy plant was set in its place. This plant—which is conspicuous in the foreground of the illustration—was remarkably strong and vigorous for a period of three weeks, when it contracted the disease. In the meantime another plant—shown in the background—died from the disease. Late in the winter the remaining plants were removed from the box, the soil was again treated with ammoniacal carbonate of copper and fresh seedlings were set in it; but these plants also contracted the disease. Just before this last treatment was given a 10-inch pot was filled from the soil in the box, and a seedling from the same lot as those placed in the box was planted in it. The pot was set in the tomato house. This plant showed the disease in less than three weeks. The question at once arises if the disease was not communicated through the air from infected plants, rather than through the soil. This I cannot answer, but it is certain that the disease travels from plant to plant which stand in separate boxes, and whose tops do not touch. Through what distances this transfer can take place I do not know. We observed it to have occurred through a distance of two or three feet, but a plant which stood fifteen feet from diseased plants, but separated from them by a glass partition in which two doors stood open, did not take the blight. It is still possible that we may

find a successful treatment for diseased soil, if all affected plants can first be removed from the house.

All our experiments, therefore, simply lead us to the conclusion that the best treatment for this winter blight is to remove all diseased plants at once, and if it becomes serious to remove all the plants and soil in the house and start anew. They emphasize the importance of starting with new plants and fresh soil every fall. And all our experience has shown that the disease is fatal to success in tomato forcing, for we lost our crop in an endeavor to treat it.

2. COMMON BLIGHT (*Cladosporium fulvum*).—The blight which is oftenest associated with the forcing of tomatoes appears as cinnamon-brown spots on the under surfaces of the leaves, as indicated by the dot-shaded portions of the leaflet in Fig. 3. For-



FIG. 3.—Common Blight (*Cladosporium fulvum*).

tunately, this fungus is rarely serious. For ourselves, we have had no experience with it, but I see it occasionally in tomato houses. It is apt to appear in late winter or early spring, often not until the winter crop is nearly harvested. In such cases, the burning of the old plants as soon as the last fruit is off will be the best treatment. If it appears earlier, however, spraying with ammoniacal carbonate of copper is to be recommended.

3. Root-Gall.—Nematode injuries of roots have received much study of late and the attention of growers has been called to them in bulletins and in the press. But there are still very few

horticulturists who are aware of the extent to which they infest our greenhouses. Many common plants, as geraniums, begonias and coleus, are subject to their attacks, and the diseased plant—or the soil in which it grew—is often dumped into the dirt-bin, where it propagates the trouble. In the southern states the nematodes are serious enemies to many plants in the field, even to trees, but in the north they confine their attention mostly to in-door plants. This indicates that severe frost is fatal to them, and suggests a remedy in the freezing of houses which are seriously attacked, when this can be done to advantage, as between the crops of winter tomatoes. Nematodes are very minute animals belonging to the true worms, and allied to the trichinæ. These nematodes are a serious menace to tomato growing under glass. They attack the roots, causing the formation of galls, as in Fig. 4. The injury to the root is often much greater than that shown in the illustration. Sometimes the whole root is swollen into one ragged shapeless mass, strongly reminding one of the club-root of cabbage. The trouble is likely to be worst in those plants which are carried over from the preceding winter. In general appearance, plants injured by root-galls are very like those attacked by the winter blight already described, save that the leaves do not show a spotted discoloration. The plants become weak, stop growing, the leaves curl and become yellow and dry, much as if the plant were suffering for water.

The treatment for this disease is to remove the plants and soil, thoroughly wash the benches or boxes with lye, and begin anew. But it would be a great saving of time and expense if the soil could be treated, between the crops, with some material which would destroy the nematodes. This was tried in a small way. Five boxes, each containing four diseased plants, were selected for treatment December 11th, 1891. The plants were removed, and the soil was treated as follows:

1. One-third pound of concentrated commercial lye dissolved in a pail of water.
2. Two pounds of salt in a pail of water.
3. One pound of quick-lime in a pail of water.
4. Four tablespoonfuls of bisulphide of carbon poured into holes which were quickly closed.

5. The box removed out-of-doors and allowed to freeze solid. These boxes are 18 inches square and contain 10 inches of soil. Clean young plants were set in them after the lapse of four or

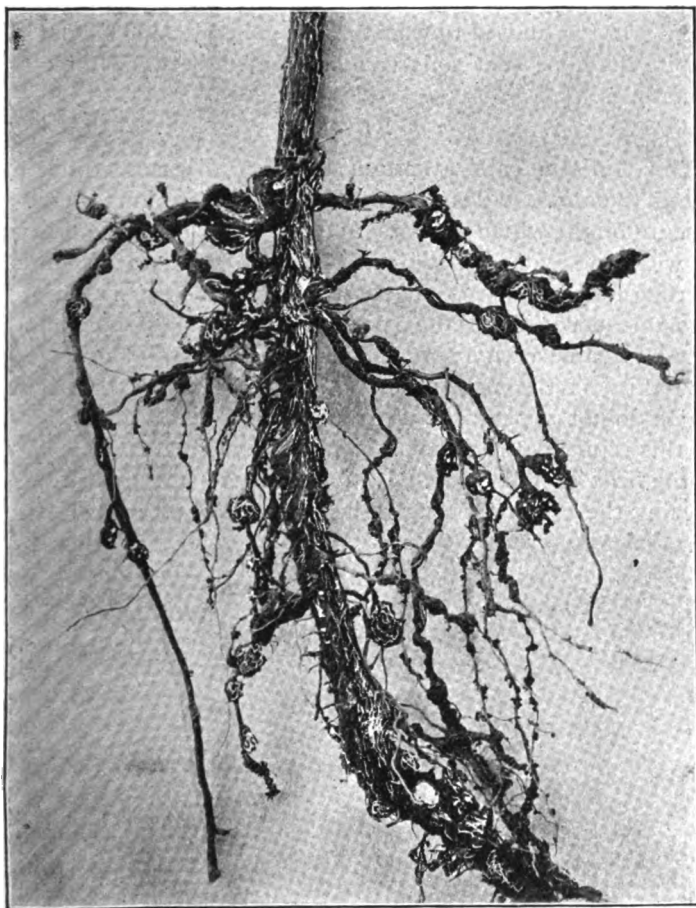


FIG. 4.—*Root-galls.*

five days, and the boxes were set side by side in the tomato house. One or two of the plants died in the soil treated with lye, and the places were refilled, while three settings had to be made in No. 2, because of the great amount of salt in the soil. Between each

setting the salt was washed out by heavy watering. When the plants were removed six months afterwards, it was found that all contained galls except those in boxes 2 and 5 — those salted and frozen—but upon these no galls whatever could be found. The results were definite and satisfactory, but the experiment was too limited to warrant any general conclusions. They inspire the hope that soils can be treated between the crops for nematodes.

REVIEW.

This bulletin calls attention to three diseases which attack forced tomatoes, at least two of which are serious. One is an obscure blight which appears to be caused by a bacterium, but for which no remedy is known. Removal of diseased plants, and thorough renovation of the house if the disease is serious, are recommended. One is the common blight or cladosporium, which is to be treated with a spray of ammoniacal carbonate of copper. The third is the nematode root-gall, the exact indications of which do not appear above ground. The prescribed treatment for this injury is the removal of plants and soil, and the washing of the beds or boxes with lye ; but there are indications that freezing the soil or treating it heavily with salt may destroy the nematodes.

L. H. BAILEY.

*U.S. Nat. Mus.
No. 28-1892.*

Bulletin 44.

October, 1892.

**Cornell University Agricultural Experiment Station
ENTOMOLOGICAL DIVISION.**

**THE
PEAR-TREE PSYLLA.**



By MARK V. SLINGERLAND.

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TOMATO NOTES FOR 1892.

1. *Quick and Slow Fertilizers.*—The influence of heavy manuring upon tomatoes has engaged our attention for a number of years. It is a common belief that the tomato, unlike most plants, is not benefited by rich soil or heavy fertilizing. "The plants run to vine," the gardeners say. There must be some truth in this belief, else it could not have become so widespread and be held so tenaciously. Productiveness in the tomato in the northern states is largely, if not chiefly, a question of early bearing: the plant will outlive any northern season, and its life is therefore determined by contingencies of frost rather than by any inherent limit of duration. The plant never matures here, and it would probably continue to bear for some months if not destroyed. We have carried plants in bearing condition through two winters. It is apparent, therefore, that any fertilizer which is not at once available to the plant but which gives up its materials comparatively late in the season, will maintain a vigorous growth and probably delay fruitfulness. Coarse stable manures belong to this class. It is some time before they become thoroughly decomposed and incorporated with the soil, and if applied heavily it is probable that they will give unsatisfactory results. If the season were long enough to allow the plant to live out its natural lifetime it is conceivable that the materials would be gradually used and that the total productiveness of the plant would be as great, if, in fact, not greater, than it would have been under a treatment which caused it to bear heavily at an earlier period. Thoroughly decomposed manures ought to give quicker and therefore more satisfactory results than coarse ones, and proper concentrated fertilizers might give better results than either. It would be interesting to know if stable manure applied in the fall,—and which therefore becomes thoroughly incorporated with the soil before spring,—

will give earlier fruitage than similar manure applied in the spring. We tried this experiment the past season, but the soil in the plots proved to be so heterogenous in character that we have no confidence in the results. We made a very suggestive test in this direction last year with nitrate of soda. Upon a certain area the material was applied all at once early in the season (June 25), and upon another equal area the same amount of nitrate of soda was applied in four applications from June 25 to August 28. Up to about the first of October, the yield from the first or single treatment area was 20 per cent. greater than from the other; but when the last picking (October 5) was added, the single treatment area fell some 8 per cent. behind. "This means," as the bulletin states, "that the intermittent application of fertilizer in lot two was beginning to be felt late in the season, while the single early application of the same amount of fertilizer gave quicker results. Frost held off until the second week in October, so that it happened that the intermittent fertilizing gave us the better result, but had frost come the last of September, as it frequently does at Ithaca, it would have given us the poorer result." This year the frost did come early (October 1), and the intermittent fertilizing gave us the poorer result. The figures which follow afford a most striking confirmation of the foregoing remarks, and they will bear careful study. Four plots, containing 15 plants each, were under experiment. In the first plot, 3 lbs. of nitrate of soda was applied at one time early in the season (June 20); in the second, the same amount was applied in four applications from June 20 to July 27; in the third, this amount was applied at four different times from June 20 to August 26, thereby extending the growing season very greatly; the fourth plot had no fertilizer. The plants were set in the field June 1, and they were all Ignatum. Table I gives the yields until frost (October 1). Table II gives the total yield found by adding to Table I all the fruits which remained on the plants after they had been killed by the first frost.

TABLE I.—SINGLE VS. INTERMITTENT FERTILIZINGS, TO FROST.

Plots. 15 plants each.	Average num- ber of fruits per plant.	Average wt. of	Average wt. of
		crop per plant. Lbs.	individual fruits. Ozs.
1. Single application. 3 lbs ni- trate of soda, June 20.....	24.2	10.0	6.6
2. Four applications. 12 oz. each, June 20, June 28, July 11, July 27	20.0	8.7	6.9
3. Four applications. 12 oz. each, June 20, July 21, August 8, Au- gust 26.....	15.2	6.6	6.9
4. Check	15.8	5.8	5.9

TABLE II.—SINGLE VS. INTERMITTENT FERTILIZINGS, TOTAL CROP.

Plots. 15 plants each.	Average num- ber of fruits per plant.	Average wt. of	Average wt. of
		crop per plant. Lbs.	individual fruits. Ozs.
1. Single application of 3 lbs. ni- trate of soda, June 20.....	53.3	17.8	5.3
2. Four applications of 12 oz. ni- trate of soda, June 20, June 28, July 11, July 27.....	51.6	16.6	5.1
3. Four applications of 12 oz. of nitrate of soda, June 20, July 21, Aug. 8, Aug. 26.....	44.2	14.4	5.2
4. Check	31.1	9.8	5.3

The second column of figures gives the total yields. It will be noticed that the best yields, in each table, are given by the single fertilizing, and that between the intermittent fertilizings the one which was completed first (No. 2) gives the better result. This was true in both the yield before frost and in the total yield, but it must be observed that in the total yield the differences between the intermittent fertilizings and the single fertilizings are not so great as in the yield to frost ; that is, the intermittent fertilizings

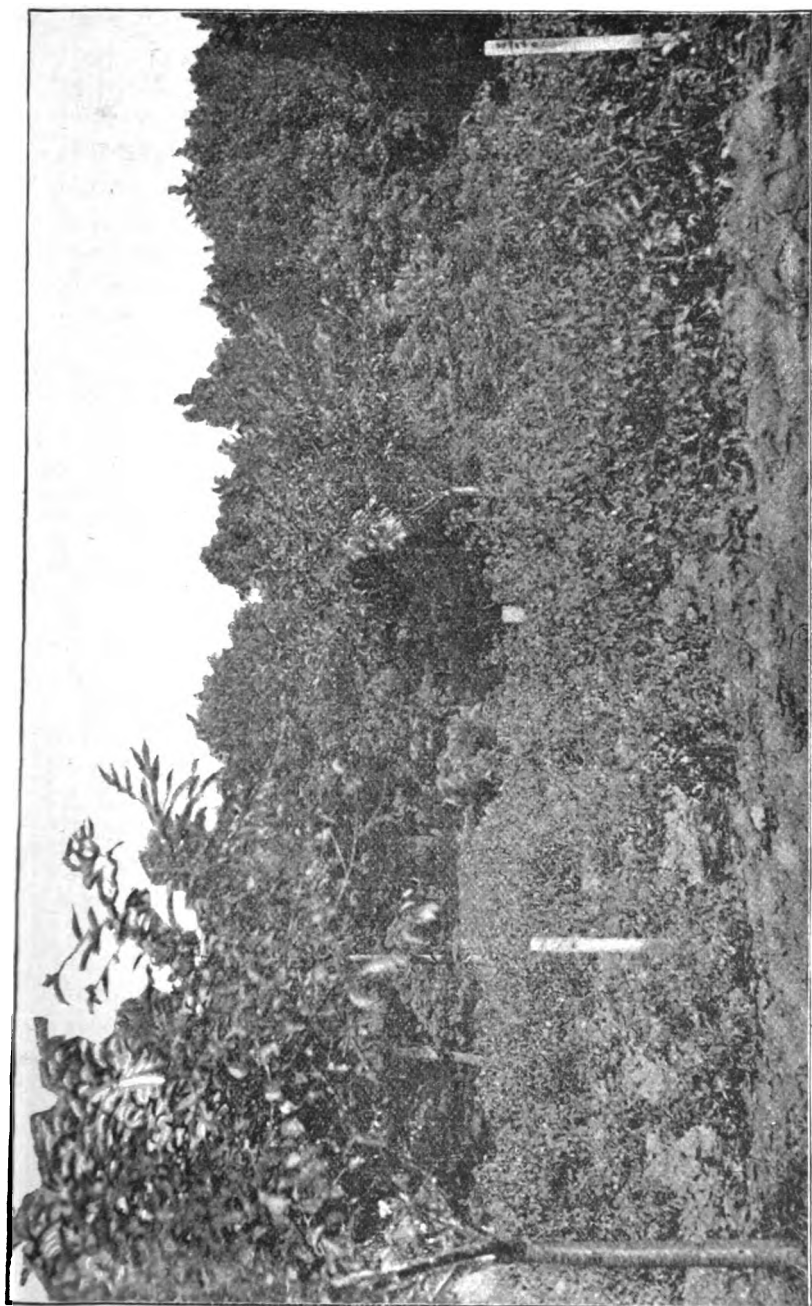
were catching up, and would probably have surpassed the other had the season been a month longer. Thus, in the first table, the first intermittent plot (No. 2) is 13 per cent. less in yield than the single treatment plot, but in the second table it is only 6.7 per cent. less; the second intermittent plot (No. 3) is 34 per cent. less in the first instance and only 19 per cent. less in the second instance. It will be noticed, also, that the number of fruits—in the first column of figures—follows the same course. All this is proof that productiveness in the tomato is largely a question of early bearing and that the best tomato fertilizers are those which give up their food materials quickly.

It must not be understood, however, that this early productiveness necessarily implies earlier individual fruits; that is, the idea refers rather to the production of many fruits—heavy pickings—early in the season rather than to the actual few first ripe fruits. A detailed account of the pickings from the plots illustrates this:

TABLE III.—SINGLE VS. INTERMITTENT FERTILIZING.
Detail Record

Date.	Plot 1. Single Fertilizing.		Plot 2. Intermittent Fertilizings. June 20-July 27		Plot 3. Intermittent Fertilizings. June 20-Aug. 26		Plot 4. Check.	
	No. fruits picked.	Wt. of picking	No. frts picked.	Wt. of picking	No. frts picked.	Wt. of picking	No. frts picked.	Wt. of picking.
July 27.....							1	...
Aug. 8.....	6	1 lb.	6	1 lb	4	1 lb.	12	4
Aug. 20.....							13	4
Aug. 22.....	25	9	32	9	13	4	8	2
Aug. 29.....	34	14	14	5	8	3	17	7
Sept. 2.....	42	17	29	12	11	6	30	11
Sept. 6.....	4	1	1	...	1	...	2	1
Sept. 8.....	77	31	60	27	52	23	50	19
Sept. 14.....	42	20	52	26	64	28	44	18
Sept. 21.....	32	14	36	18	27	12	22	9
Sept. 28.....	102	39	50	21	48	20	39	10

It appears that all the fertilizer plots were about equally early in first fruits, but after the first two pickings the single treatment plot gave the heaviest returns, and this advantage was main-



The Effect of Nitrate of Soda. The Nitrate was applied to the right-hand portion. Notice the bare spots in the no-treatment portion on the left.

tained throughout the picking season. As between the two intermittent treatment plots (Nos. 2 and 3), it will be observed that heavy pickings were much more early in No. 2, in which the fertilizing was completed late in July. The habit of the variety as to the season of its bearing was not greatly affected by the different treatments, but the amount of fruit borne at stated intervals was greatly influenced. It is probable that the plant had determined the date of its first fruiting, so to speak, before the fertilizer became available to it, for the plants were beginning to flower when the first application was made ; but as soon as the fertilizer came into use, the habit of the plant was influenced, and the late fertilizing delayed, in a measure, the productiveness. At all events, I can offer no other explanation of the facts at the present time.

But these tests afford a means of comparing nitrate of soda with no fertilizing, for the check plot (No. 4) received no treatment. In each case, the check plot gives the poorest results, showing that nitrate of soda has a distinct value as a fertilizer. The differences in the appearance of the two plots (Nos. 1 and 4) is well shown in the accompanying engraving (page 193) in which the check plot occupies the left-hand portion. This appears like a contradiction of some of our former experiments in which we found no benefit to arise from the use of this material. But in former tests, the soil was very poor and there was very little potash or phosphorus to mate the nitrogen in the nitrate of soda ; but in this test, the soil was fairly good. If we repeat our statements of a year ago, it will be seen that our present results are a confirmation of former trials rather than a contradiction of them : "It should be borne in mind that this substance [nitrate of soda] is an incomplete fertilizer and that unless the soil contains potash and phosphorus in sufficient amount the nitrate is nearly valueless. It is simply a convenient and useful form in which to apply nitrogen alone." So that, while nitrate of soda is a good tomato fertilizer when applied early upon fairly good soils, we cannot recommend that anyone should rely upon it exclusively year after year. Potash and phosphoric acid must also be applied at intervals.

2. *General Fertilizer Tests.*—We shall pursue this study of nitrate of soda still further in the following tests of the influences of nitrogen, potash, and phosphorus applied separately and in combination. Eight plots of six plants each, upon fairly good gravelly soil which had been sparingly enriched in previous years, were treated as follows June 20, the yield being given in the second column of figures :

TABLE IV.—FERTILIZER TEST, TO FROST.

Plots, 6 plants each.		Average no. of fruits per plant.	Average wt. of fruit per plant.	Average wt. of individual fruits.
			Lbs.	Ozs.
1	Nitrate of soda 1 lb...	30.0	9.5	5.07
2	Bone black 2 lbs...	19.6	5.8	4.8
3	Muriate of potash 1 lb...	24.2	7.7	5.1
4	{ Nitrate of soda 1 lb...	20.0	7.2	5.7
	{ Bone black 2 lbs...			
5	{ Nitrate of soda 1 lb...	27.5	7.1	4.4
	{ Muriate of potash 2 lbs...			
6	{ Bone black 2 lbs...	21.0	8.8	6.7
	{ Muriate of potash 1 lb...			
7	{ Nitrate of soda 1 lb...	19.8	7.3	5.9
	{ Bone black 2 lbs...			
8	{ Muriate of potash 1 lb...	23.4	8.9	6.1
	Check.			

TABLE V.—FERTILIZER TEST, TOTAL CROP.

Plots, 6 plants each.		Average no. of fruits per plant.	Average wt. of crop per plant.	Average wt. of individual fruits.
			Lbs.	Ozs.
1	Nitrate of soda 1 lb...	50.6	14.5	4.5
2	Bone black 2 lbs...	25.4	7.2	4.5
3	Muriate of potash 1 lb...	34.6	9.6	4.4
4	{ Nitrate of soda 1 lb...	35.3	10.5	4.7
	{ Bone black 2 lbs...			
5	{ Nitrate of soda 1 lb...	36.0	8.0	3.6
	{ Muriate of potash 2 lbs...			
6	{ Bone black 2 lbs...	29.5	10.5	5.7
	{ Muriate potash 1 lb...			
7	{ Nitrate of soda 1 lb...	48.2	14.4	4.8
	{ Bone black 2 lbs...			
8	{ Muriate of potash 1 lb...	40.2	12.6	5.0
	Check.			

The first of these tables shows that nitrate of soda gave the heaviest yield before frost, and it was the only treatment which gave as good results as the check plot, which had no fertilizer. It is to be observed, also, that while bone black and muriate of potash gave the poorest results as single fertilizers, they gave the best result of any of the combinations. If we turn to table V., however, and study the total yield of the season, we notice that the nitrate of soda plot has perceptibly gained in proportional yield, and that the best combination is No. 7, which contains nitrate of soda; but the combination plot gives a trifle poorer results than the nitrate alone. These two instances are also the only ones which equal or exceed the yield of the no-treatment plot. These tests are a repetition of a series made in 1891, when one-fortieth acre plots were used. Last year, however, the trial was made upon very poor and intractable soil and nitrate of soda gave the smallest yields of the single treatments, and the best yield was obtained from a combination of all three materials, but even then the crop averaged to frost only 3.3 lbs. per plant, against 9.5 lbs. in the best yield this year, in a shorter season. The experiments of 1891 seem to show, therefore, that on very poor land nitrate of soda alone gives very little result, all the three elements being needed to produce even a small yield; the experiments of 1892 seem to show that upon tolerably good soil nitrate of soda alone may give profitable results, and this conclusion is strengthened by the other evidence which has been presented in this paper.

3. *Relation of Variety to Fertilizing.*—Last year we raised the question as to whether there is any difference between varieties in the readiness with which they respond to fertilizers. Are some types of varieties more likely to give good results from manuring than others? The small test made upon this point last season showed a decidedly greater tendency on the part of improved or highly developed varieties, like the Ignotum, to produce more fruits to the plant, but the total weight of crop did not appear to follow this course. This year, five varieties were submitted to this test, Ignotum representing the more improved types, Ithaca and Peach the intermediate types, and Yellow Plum and Red Cherry the least improved ones. On June 20, nearly three weeks after the plants were set in field, each plot, containing six

plants, received a liberal dressing of equal parts of nitrate of soda, muriate of potash, bone black and Bradley's vegetable fertilizer. The yields to frost are displayed in the following table:

TABLE VI.—RELATION OF VARIETY TO INFLUENCE OF FERTILIZER.

Variety. 6 plants.	Average no. fruits per plant.			Average weight of crop per plant.			Average weight of in- dividual fruits.		
	Unfer- til- ized.	Ferti- lized.	Per cent. in- crease.	Unferti- lized.	Ferti- lized.	Per cent. increase.	Unfer- til- ized.	Ferti- lized.	Per cent. decrease.
Ignotum	19.0	23.5	23.7	7.3	9.9	35.6	6.2	6.8	9.6 gain
Ithaca	38.8	50.2	29.3	12.6	13.7	8.7	5.2	4.3	1.7
Peach	23.7	38.6	62.8	2.5	4.2	68.0	1.7	1.7	0.0
Yellow Plum	25.3	35.3	39.5	6.8	9.3	36.8	0.43	0.42	23.2
Red Cherry.	269.6	273.5	1.44	4.9	4.8	2.0 loss	0.29	0.28	3.4

These results agree with those of 1891 in the fact that the least improved variety—Red Cherry, in this instance—gave the least increase in number of fruits, but beyond this there appears to be no uniformity in the outcomes. It is remarkable that in the Red Cherry there was somewhat less total yield in the fertilized plot than in the other; yet the Yellow Plum, which is very little superior to it in degree of amelioration, gives a greater increase, both in number of fruits and in total weight of crop, than the Ignotum. Last year, the Ithaca gave the most remarkable response to the fertilizer, but this year it gave comparatively little response. It should be said, however, that the experiments of last year were made upon very poor soil, and the effect of the fertilizers was therefore undisguised; but this year the plots were upon good soil, somewhat variable in character, upon which the fertilizers produced comparatively small effect. We shall attempt to repeat this study upon a uniform poor soil.

4. *Early and Late Setting.*—Three lots of Ignotum, each containing twelve plants, were set in the field at different times, for the purpose of determining if the date of planting, within ordinary limits, greatly influences earliness and yield. The plants were all grown from seed sown January 19th, and they were

vigorous and stocky when set in field. The first lot, which may be designated No. 1, was set May 7. That night there was a frost and the tips of the plants were killed. Another lot was therefore set May 9. For some days the weather was cold and raw, although no frosts occurred, and for three weeks it was very wet. The third lot was set at the general planting, June 1.

TABLE VII.—EARLY AND LATE SETTING. Total Crop.

Plot.	Date of first picking.	Avg. no. of fr'ts per plant.	Average wt. of crop per plant.	Avg. wt. of individual fruits.
No. 1. Set in field May 7	Aug. 22.....	23.8	8.5	5.8
No. 2. " " " 9 July	July 27.....	26.7	9.5	5.7
No. 3. " " " June 1	" 27.....	26.2	8.8	5.4

The results are decidedly in favor of the second planting, made May 9. Even the frosted lot nearly equalled the main planting, but the plants were so checked that the first ripe fruits were three weeks later than in the other lots. It will be noticed, however, that lot 2 was no earlier, so far as first fruits are concerned, than the late planting, but the first pickings were heavier in lot 2. In both lots, the flower buds had already appeared when the plants were set, so that the first fruits were already determined; in the earliest lot, these buds had been killed by frost. The following is a detailed account of the behavior of the plants to frost:

TABLE VIII.—EARLY AND LATE SETTING. Detail Record.

Date.	1. Set May 7.		2. Set May 9.		3. Set June 1.	
	Whole no. fr'ts picked.	Weight of picking.	Whole no. fr'ts picked.	Weight of picking.	Whole no. of fr'ts picked.	Weight of picking.
July 27.....	.....	.....	1	.....	7	1
Aug. 8.....	.....	.....	.....	.....	3	1
Aug. 22.....	13	3	11	6	7	1
Aug. 29.....	26	8	23	7	26	7
Sept. 2.....	71	21	54	19	45	17
Sept. 8.....	43	20	50	20	61	25
Sept. 14.....	47	18	48	19	37	14
Sept. 21.....	34	13	45	15	53	13
Sept. 28.....	52	17	89	26	75	22
	286	100 lbs.	321	112 lbs.	314	101 lbs.

It will be noticed that the lessened productiveness of lot 1—the earliest setting—as compared with the main setting in lot 3, was due to the delay of fruiting caused by the injuries of the frost, for the pickings, when they once began, averaged heavier than in the latest setting. The great advantage maintained by the second setting—lot 2—was not due to absolute earliness, but to early productiveness; and this supports the conclusions which we have already drawn from our studies of fertilizers, that productiveness in the tomato is chiefly a question of early prolific bearing. These remarks may also throw some discredit upon the common method of determining comparative earliness of varieties by recording the date of the first ripe fruit: profitable earliness is determined by the ability of the variety to maintain heavy early pickings rather than by the date at which the few first fruits ripen.

This is the third year that we have made this test upon early and late settings, and our results have been substantially alike throughout,—that tomato plants are not injured by the cold raw weather of late spring, and that a slight frost may not greatly retard them. This conviction has been an unwilling one on the part of the writer, for he entertained the belief that the inclement weather of early May in the northern states is very prejudicial to the tomato. In our tomato bulletin for 1889 this statement was made: "It is a common mistake to set tomato plants in the field too early. Cold nights, even though several degrees above frost, check the plants, sometimes seriously." This statement now seems to be much too strong, and we are gradually adapting our general practice to our new belief. In 1889, our tomatoes were set in field June 10 to 12; in 1890, they were set June 12; in 1891, June 10; in 1892, June 1; and next year we shall set our plants in May.

5. *Early and Late Seed Sowing.*—In 1889 we made some tests to determine if it pays to start tomato plants under glass with artificial heat, rather than to wait until they can be started under cold frames. Sowings were made March 21 and 22, April 10, 12 and 15, and May 15. "In every instance the early sown plants gave earlier fruits than the others." "The gain in earliness sometimes amounts to three or even four weeks." We were:

satisfied that in this climate it pays to start tomatoes as early as the middle of March. Farther south, where the seasons are longer, this may not be true. The question now arises if it pays to start tomatoes earlier than March, for this state. Four lots of Ignoutums, twelve plants in each, were grown for a test. The first lot was sown January 19, and the plants were transplanted February 1, March 3, and May 17. The second lot was sown February 12 and transplanted March 4, April 4 and May 2. The third lot was sown February 24 and transplanted March 22 and May 2. The fourth lot was sown March 14, and transplanted April 14 and May 9. The plants were all set in field June 1, and all were thrifty and stocky plants. The outcome to frost was as follows :

TABLE IX.—EARLY AND LATE SEED SOWING.

Date of sowing.	Av. no. fruits per plant.	Av. wt. of crop per plant.	Av. wt. of individual fruits.
Jan. 19.....	20.6	8.5	6.5
Feb. 12.....	20.6	8.4	6.5
Feb. 24.....	21.0	9.1	7.0
March 14.....	26.0	11.0	7.4

The result, as read in the second column of figures, is decidedly in favor of the latest sowing, the second best yield being in the second last sowing. The earliest two sowings give practically the same results. The detailed behavior of the plants during the bearing season is recorded below :

TABLE X.—EARLY AND LATE SEED SOWING—DETAIL RECORD.

Date.	1. Sown Jan. 19.		2. Sown Feb. 12.		3. Sown Feb. 24.		4. Sown March 14.	
	Whole no. frts picked	Weight of pick- ing	Whole no. frts picked	Weight of pick- ing.	Whole no. frts picked	Weight of pick- ing.	Whole no. frts picked	Weight of pick- ing.
July 27.....	8	2 lbs.	3	1 lb.	...	...	...	...
Aug 8.....	...	...	7	2	9	3	4	1
Aug. 22.....	5	1	12	3	9	3	5	2
Aug. 29.....	11	4	12	4	25	10	8	2
Sept. 2.....	26	12	37	17	61	26	31	13
Sept. 8.....	37	19	37	16	51	23	49	25
Sept 14.....	46	20	32	14	41	17	62	32
Sept. 21.....	38	14	36	14	18	6	26	11
Sept. 28.....	77	28	72	26	37	19	100	32

The figures show that the earliest fruits were got from the earliest sowings, but at the end of August the third sowing (February 24) had exceeded the earlier ones in yield. It was not until the middle and late September pickings that the fourth lot began to gain over the others, and by the last of the month it had surpassed them all in yield. Our experiments of four years ago show that it is profitable to start tomato seeds in this climate as early as the middle of March; our experiments this year show that it is not profitable to start them earlier than the middle or first of March. But inasmuch as earlier fruits can be got by earlier sowings, it may be worth while to start a small part of the crop in the middle or first of February if an early market is to be supplied; but the cost of this extra care and handling must be reckoned. The main crop, it appears, should be started in March.

But it must be said that much depends upon the manner in which the plants are handled. Early plants must be transplanted to keep them growing, and they must have congenial surroundings. We tried to determine the effect of ill treatment. A lot of vigorous seedlings, in pots, were placed in a cold and leaky house. The pots were packed in moss and set upon a cold, damp earth floor. Several times the mercury fell nearly to the freezing point.

The plants became yellow and weak, and were finally unable to support themselves readily. In this condition the plants were taken into the tomato house and given the most careful nursing. They never outgrew the disaster. Yet plants little better than these are often set in the field to shift for themselves!

6. *Few and Several Transplantings.*—The vigor and stockiness of plants, as we have said in the last paragraph, are important features, and these are greatly influenced by the frequency of transplanting. Two dozen uniform Ignotum plants were selected from a sowing made in flats March 14. One dozen were transplanted once, May 18th, into 4-inch pots; the others were transplanted three times, April 14, May 9 and 17, into a flat, 3-inch and 4-inch pots respectively. All were again transplanted into the field June 1.

TABLE XI.—FEW AND SEVERAL TRANSPLANTINGS, TO FROST.

Plot.	Date of first picking.	Average no. of fruits per plant.	Average wt. of crop per plant.	Average wt. of individual fruits.
No. 1, transplanted once.	Aug. 22	17.3	Lbs. 8.5	Ozs. 7.8
No. 2, transplanted three times.....	Aug. 3	22.2	8.3	5.9

There was very little difference in the yields of the two lots, but the three transplantings gave the earlier fruits, and in this respect the results agree with those obtained last year. In 1891, in a comparison of one, two and three transplantings, all lots being duplicated, the two transplantings gave decidedly the heaviest yields.

7. *Flat-grown vs. Pot-grown Plants.*—It is a question whether young tomato plants thrive better in "flats,"—or shallow tray-like boxes in common use among gardeners—or in pots. From each of two sowings of Ignotum, made February 12 and March 14 in flats, two dozen uniform plants were selected. One dozen, in each instance, were transplanted into flats, and one dozen into pots, on the same days. The transplantings were made as follows:

Series I (sown Feb. 12), March 4, April 4, May 5.

Series II (sown March 14), April 4, May 9.

The flat-grown plants in each instance were set so far apart in the flats that the plants could not interfere with each other, and at the final transplanting they stood from three to four inches apart each way. The pot-grown plants in the first series were transplanted into thumb pots and then into 3-inch and 4-inch pots. In the second series, they were placed in 3-inch and 4-inch pots. The records are these :

TABLE XII.—FLAT-GROWN VS. POT-GROWN PLANTS.

Samples.	Average no fruits per plant.		Average wt. of crop per plant.		Average wt. of individual fruits.	
	Flat.	Pot.	Flat.	Pot.	Flat.	Pot.
<i>Series I.</i>						
March 14	30.4	26.0	11.2	11.6	5.7	7.0
<i>Series II.</i>						
February 12	20.5	31.0	8.6	11.5	6.7	5.9

The yields, in the second double column of figures, are decidedly in favor of pot-grown plants, especially in the later sowing. And it may also be said, although the table does not show it, that the pot-grown plants gave earlier fruits.

8. *Seedlings vs. Cuttings.*—In 1890, seedling tomato plants gave twice as heavy yields as cuttings of equal age. In 1891, seedlings gave earlier fruits, and with one variety—Lorillard—the yield was also much greater from seedlings, while in the Ithaca it was less. Secondary cuttings, that is, cuttings taken from the cutting plants, gave much larger yields than their parents, but the crop was much later. These experiments were repeated this year. The stock from which all the lots of this year came was one fine seedling plant of unknown parentage, of the Peach type, which came up in our forcing-houses. Late in winter, strong cuttings were taken from the axillary shoots of this plant and were set out regularly in our tomato house. In March, therefore, we had the one old or parent plant, still in full vigor, which we shall call A, and a small brood of cutting plants which we shall call, collectively, B.

March 29, 12 cuttings were taken from A. These cuttings were three to four inches long, and comprised the entire length of vigorous axillary shoots. At the same time, seeds were sown from fruits on the same plant. The two lots were thereafter treated as nearly alike as possible. They were set side by side in the field, June 1. Their behavior was as follows :

TABLE XIII.—SEEDLINGS vs. CUTTINGS (To Frost.)

Samples (March 29.)	First Pick- ing.	Av. no. frts. per plant.	Av. weight frt. per plant.	Av. weight in- dividual frts.
Seedlings.....	Aug. 22.....	23.6	3.0 lbs	2.0 oz..
Cuttings.....	Aug. 3.....	43.	4.8 lbs.	1.8 oz.

Here, then, the cuttings were both much earlier and more productive than the seedlings. This is opposed to most of our earlier results.

May 3, another batch of cuttings was taken from the old plant A. These were three or four inches long and were made from the tips of axillary shoots which had reached a foot or more in length. Seedlings were started from the same plant at the same time, and the two lots were placed side by side in the field. The results are like those above, only less pronounced :

TABLE XIV.—SEEDLINGS vs. CUTTINGS (To Frost).

Samples, May 3.)	First pick- ing.	Av. no. frts. per plant.	Av. weight frt. per plant.	Av. weight in- dividual frts.
Seedlings	Sept. 2.....	12	2.1 lbs.	2.9 oz
Cuttings	Aug. 22.....	15.3	2.3 lbs.	2.3 oz

Now, at the same time that this last lot was started, May 3, a dozen good cuttings were taken from the plants B, which were themselves cuttings. These cuttings of cuttings were given the same treatment as the cuttings specified in the above table, and were set alongside them in the field. They gave their first pick-
ing August 22, the same date as the one-generation cuttings, but

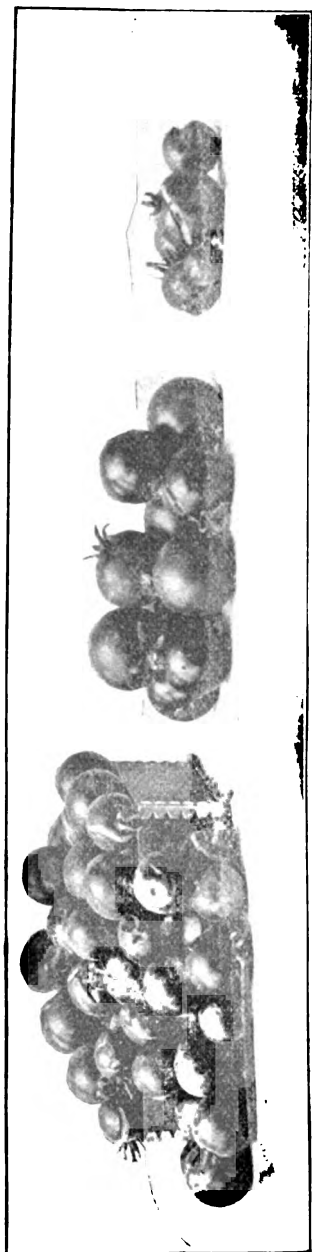
they gave over twice the yield of either cuttings or seedlings—5.4 lbs. per plant, which is a fair yield for plants started in May. This, in general, tallies with our experience last year. We cannot account for it. Another strange thing about these cuttings of cuttings is the fact that they did not reproduce the parent type, A, but of this we do not feel competent to speak more fully at present.

9. *Products of Early and Late Fruits.*—A house plant of the Currant-Ithaca hybrid described last year (Bulletin 32, p. 165) gave its first ripe fruit December 3, 1891. Seeds were saved from this, and also from another fruit upon the same plant which matured March 18, 1892. These seeds were sown at the same time and at this time, also, cuttings were taken from the plant. The three lots made the following record :

TABLE XV.—PRODUCTS OF EARLY AND LATE FRUITS. (To Frost.)

Samples.	Date of first picking.	Av. no of frts. per plant.	Av. wt. of frts. per plant.	Av. wt. of ind. fruits.
			Lbs.	Ozs.
1. First ripe fruit.....	July 27.....	76.4	1.1	0.22
2. Late ripe fruit.....	July 27.....	117.8	2.1	0.29
3. Cuttings	June 20.....	120.3	1.8	0.25

The poorest results were got from the seeds of the earliest fruit. The earliest picking was obtained from the cuttings, but the heaviest yield came from seedlings of the late fruit. The light yields are due to the variety, it being a cherry-like tomato. The table also affords a comparison of seedlings and cuttings, as



Products of Early and Late Fruits and Cuttings, at the first general picking. The left-hand and right-hand samples show products of late and early fruits respectively; the middle lot is from cuttings.

discussed in § 8, the cuttings being earliest, and producing more than one lot of seedlings and less than another. The accompanying picture shows the status of these three lots at the picking of July 27. The left-hand sample comprises all the fruits picked from the dozen plants of No. 2—products of late fruit; the middle one those picked from No. 3—the cuttings, and the right-hand sample is the picking of No. 1—the product of first ripe fruit. It may seem strange that early fruits should give less yield than late ones, but the result is not novel. We found the same thing to be true last year in a number of varieties, and similar results have been obtained elsewhere. In our experiments last year there were no constant differences between the sets in point of earliness. This illustrates the law that any fruit reproduces its parent rather than itself: that is, the character of the plant as a whole is more important than the character of any individual fruit upon it. We should therefore expect better results in earliness by selecting fruits from an early plant rather than by selecting early fruits from an ordinary plant.

10. *Products of Mature and Immature Fruits.*—In March, a fully ripe fruit, and one which was full grown and was about to begin to color, were selected from a house-grown plant of the Brick tomato—a large, regular, red variety. Plants were grown from each lot of seeds.

TABLE XVI.—PRODUCTS OF MATURE AND IMMATURE FRUITS.

Samples.	Date of first picking.	Average no. of fruits per plant.	Average wt. of fruit per plant.	Average wt. of individual fruits.
Mature.....	August 8	26.0	Lbs. 12.0	Ozs. 7.4
Immature.....	" 22	24.7	11.1	6.9

The mature fruit lot gave the better results, both in earliness and yield.

11. *"Leggy" Plants.*—Plants which have grown tall and spindling are known among gardeners as "leggy" plants, in distinction to those which are "stocky," or short and stout. Leggy plants usually give very poor results in the field when set in the ordinary manner; but some growers obtain good returns from them by laying the stem upon the ground or in a little trench, when setting, and covering it with earth, allowing only a few inches of the tip to protrude. This treatment prevents the breaking of the plant by the wind, and roots will form along the buried portion which may aid in the production of a crop of fruit. This system was tried last year, but the layered leggy plants gave less results than normal plants set in the ordinary fashion; but they gave better results than leggy plants not layered. Our leggy plants last year were very poor, however; they were so badly drawn that they could scarcely stand alone. This year the effort was repeated, but the drawn or leggy plants, while tall and slender, were still able to support themselves, and they were vigorous. The lots for this year's test came from Igrotum seeds sown February 12. All the plants were transplanted at the same times, March 4, April 4, May 2, and were set in field June 1. Lot No. 1 was transplanted into pots at the first shifting. At the date of setting in the field they were in 4-inch pots, and were short,

stocky plants of ordinary dimensions. Lot 2 was also grown in pots of the same sizes, but the plants stood amongst a general collection of other plants, and because of lack of room and light, ran up 18 or 20 inches high. Lot 3 was grown entirely in flats, being given more room at each shifting, but the plants were allowed to grow 18 or 20 inches tall from crowding. Lot 1 was set in the field in the ordinary manner. Lots 2 and 3 were trimmed of their lower leaves, the root was set at the ordinary depth—three to four inches—and half the length of the slender stem was laid down and covered in a trench of the same depth, the free portion lying nearly parallel with the surface of the ground. The following figures show how all these lots behaved :

TABLE XVII.—“LEGGY” OR DRAWN PLANTS.

Lots.		First pick- ing.	Average no. fruits per plant.	Average wt. of fruit per plant.	Average wt. individual fruit.
1	Check. Normal setting	August 8	12.	Lbs. 4.3	Ozs. 5.8
2	Leggy, pot-grown.....	" 8	19.5	7.3	6.
3	" flat-grown	" 22	12.2	4.4	5.8

These figures show plainly enough that the layered leggy pot-grown plants gave decidedly best results, and that even the flat-grown leggy plants gave slightly heavier yield to frost than normal plants, although they came into bearing later. If these figures are to be relied upon, there is some advantage in growing tall and slender plants and then laying them down in setting; but the test needs to be repeated, and it should also be said that the plants, while leggy, were still vigorous.

12. *Shearing Young Plants.*—It is a frequent practice to shear the tops off young tomato plants to make them stocky, in place of a transplanting. Two dozen *Ignotum* plants, for which seeds were sown January 19, were distributed into two lots. One lot, which we may call No. 1, was transplanted on February 1, March 3, April 14, and May 17; the second lot was treated the same way except that in place of the last transplanting, May 17, the plants were sheared. At this time the plants were some 15 inches high, and about three inches of the top was cut off.

TABLE XVIII.—SHEARING YOUNG PLANTS.

Lots.	First picking.	Av'ge no. fr'ts per plant.	Average wt. fruit per plant.	Average wt. individual fruits.
1. Normal	July 27	26.2	8.8 lbs.	5.4 ozs.
2. Sheared	Aug. 29	23.6	9.6 "	6.5 "

There was considerable loss in earliness in the sheared lot, but a gain in weight of crop before frost. This gain was not great, and too much dependence should not be placed upon it.

13. *Hilling*.—Two plots of 28 good Ignotum plants each, were set aside for a test of the value of hilling tomatoes, half of each plot being hilled July 2, the remaining halves receiving common level cultivation. The soil was drawn up around the base of the plant to a height of six inches, as potatoes are hilled.

TABLE XIX.—HILLING TOMATOES

A. YIELD TO FROST.			
Plot.	Average no. of fruits per plants.	Average wt. of fruit per plant. Lbs.	Average wt. of individual fruits. Ozs.
1 { Hilled	24.6	11.0	7.2
1 { Not hilled.....	24.6	9.8	6.4
2 { Hilled	20.5	8.5	6.6
2 { Not hilled.....	25.0	10.1	6.4
B. TOTAL FOR SEASON.			
1 { Hilled	56.4	17.9	5.2
1 { Not hilled.....	86.2	27.1	5.0
2 { Hilled	72.6	22.2	4.8
2 { Not hilled.....	61.0	18.7	4.9

The results are conflicting, although on the whole the normal or check plants gave rather the better results. In earliness there was no appreciable difference. This hilling experiment was first made last year, it having been urged upon us by a gardener who thinks that hilling gives greatly increased yields. But in both years we have found no advantage in it.

14. *Trimming*.—It is sometimes said that trimming or heading-in tomato plants in the field is an advantage, giving earlier

and heavier crops. We have tried it three years. This year, four plots of a dozen plants each of *Ignotum* were selected for treatment, three of the plots being trimmed, and the remaining one having only common treatment. The trimming consisted in heading-in the main shoots to the first fruit which had attained the size of a marble. From four to eight inches of the shoot was therefore removed. The trimming was done at different times, as recorded below :

TABLE XX.—TRIMMED PLANTS.

Plot.	Average no. of fruits per plant.	Average wt. of crop per plant.	Average wt. of individual fruits.
		Lbs.	Ozs.
1. Trimmed July 28, Aug. 8 and 30	20.2	7.7	5.7
2. Trimmed Aug. 8 and 30.....	20.4	7.6	6.0
3. Trimmed Aug. 30.....	24.6	9.3	5.9
4. Check.....	24.2	9.1	6.1

The early trimmed plants gave considerably less yield than the late trimming or the check. There was no constant difference in earliness. The figures, as they stand, seem to teach that the plants had better not have been trimmed, for although there is a trifle gain in the late-trimmed lot (No. 3), the increase is not enough to make one feel sure that it is due to the treatment. In 1890, however, trimming on July 28 and August 25 gave considerably increased productiveness and earliness. In 1891, the trimmings were made August 3, August 24 and September 18, and the results were indifferent ; it was then thought that the unsatisfactory yields were due to the lateness of the trimming, but the first trimming this year was made on the same date as in 1890, but with opposite results. So we are still in doubt as to whether trimming promises any benefit ; but it is evident that it does not yield decided results.

15. *Single-stem Training*.—A good number of *Ignotum* plants were set a foot apart in rows, and each plant was tied up to a perpendicular cord, but one stem or stalk being allowed to grow in each case. The first tying of the stem to the wire was made July 20, the plants having been set June 1. Probably earlier

attention should have been given to this. Thereafter the plants were tied every week or two, as occasion required, but this attention was not arduous. Other plants of same age and variety were set alongside, 4x4 feet apart, for comparison.

TABLE XXI.—SINGLE STEM TRAINING.

Samples.	Crop previous to Aug. 31			Crop for the season.		
	Average no. of fruits per plant.	Average wt. of crop per plant.	Average wt. of individual fruit.	Average no. of fruits per plant.	Average wt. of crop per plant.	Average wt. of individual fruit.
1. Single-stem training.....	2.9	1.08	5.9	10.7	4.0	6.0
2. Ordinary planting or check...	2.8	1.04	5.8	24.2	9.1	6.1

The second column, in each instance, shows the total yield. The trained plants gave earliest results, averaging 1.08 lbs. to the plant up to the last of August, against 1.04 lbs. from the check lot; and this difference is important because the trained plants have much less bearing surface than the others. The total product for the season is nearly half as much to the plant (4 lbs. as to 9 lbs.), but the trained plants occupy five times, and more, less ground than the others, so that the yield per acre or per square yard is two or three times greater from the trained plants. These results match those obtained last year. This is the method pursued in forcing tomatoes for winter fruit where the greatest possible yield must be produced. Both last year and this we found less fruit-rot upon the trained plots than upon others. We feel safe in recommending single-stem training for home cultivation of the tomato, and we believe that it can be made profitable for the early crop in market plantations. The plants can be tied to stakes, to cords stretched up and down between two horizontal wires, or to any support which the grower may fancy. The important points are to let but one stalk grow, and to keep it securely tied to its support.

16. *Fruit-rot.*—It is well known that the rot of the fruit is influenced to a considerable extent by the method of growing and training the tomato. Single-stem training, as discussed above, usually lessens the rot, and so does any system of training which

There are no constant variations in these figures, and apparently nothing to show that the cultivation exerted any influence upon rot. If these various treatments determine to any extent the prevalence of rot, the results were probably obscured this year because rot was everywhere very slight in our plantations.

Following is a record of the amount of fruit-rot in different varieties grown this year :

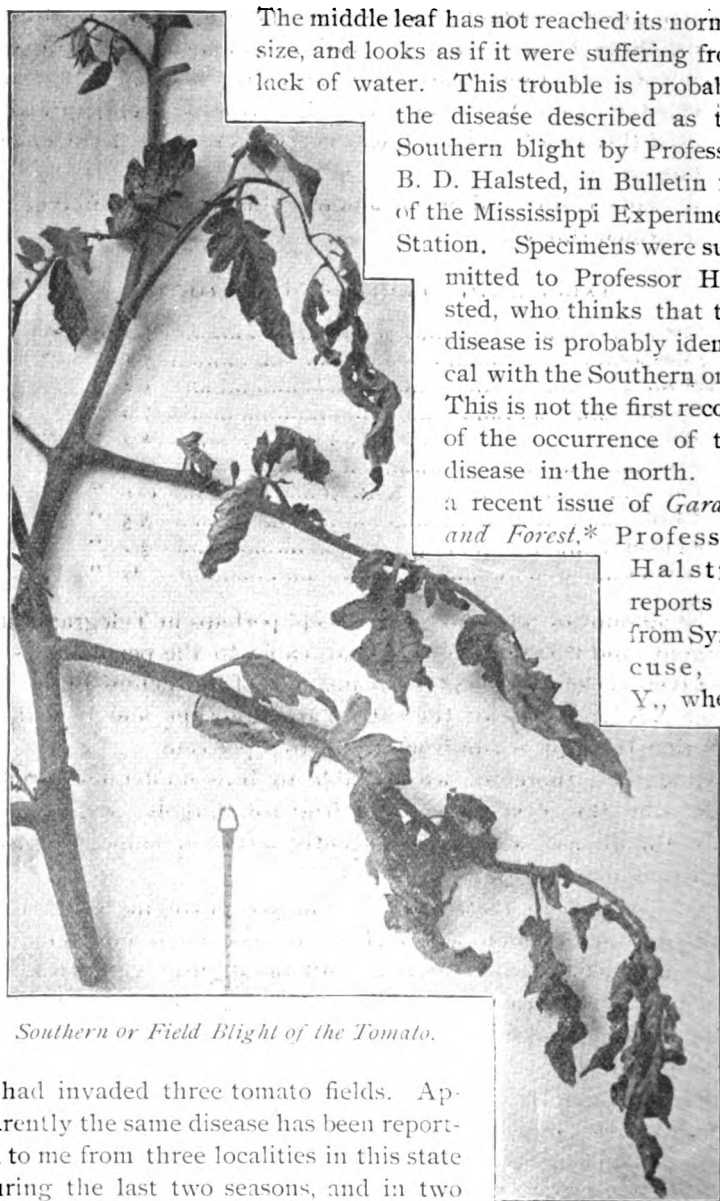
TABLE XXIII.—FRUIT-ROT IN VARIETIES.

Ignotum.....	7.0	per cent. rot.
Long Keeper.....	7.1	" " "
Nichol No. 5.....	5.2	" " "
Trophy.....	7.0	" " "
Plentiful.....	8.1	" " "
Telegraph.....	16.0	" " "
Belmont.....	10.0	" " "
Royal Red.....	5.3	" " "
Picture Rock.....	3.2	" " "
Yellow Plum.....	$\frac{1}{2}$	" " "

The amount of rot is not great except perhaps in Telegraph and Belmont, and it is probably not chargeable to the peculiarities of the given varieties, except in the instance of the Yellow Plum. In Table XXII, above, all the entries are Ignotum, and it will be seen that the figures run from 3.7 to 16.6 per cent.

Altogether, therefore, we are able to draw no definite conclusions from this year's studies of fruit-rot, largely, perhaps, because the disease was not sufficiently severe to emphasize itself in particular treatments.

17. *Southern or Field Blight*.—The accompanying illustration shows a trouble which was serious upon some of our tomatoes this year. The leaves become dull or slightly yellowish and curled, as if suffering from drouth, and the ends or individual leaflets shrivel and droop and finally become dry and black. The uppermost leaf in the engraving shows the shrivelled, dead and spindling extremity in a characteristic manner; and the lowest leaf shows the injured portion in an early stage of the disease.



The middle leaf has not reached its normal size, and looks as if it were suffering from lack of water. This trouble is probably the disease described as the Southern blight by Professor B. D. Halsted, in Bulletin 19, of the Mississippi Experiment Station. Specimens were sub-

mitted to Professor Halsted, who thinks that the disease is probably identical with the Southern one. This is not the first record of the occurrence of the disease in the north. In a recent issue of *Garden and Forest*,* Professor Halsted reports it from Syracuse, N. Y., where

Southern or Field Blight of the Tomato.

it had invaded three tomato fields. Apparently the same disease has been reported to me from three localities in this state during the last two seasons, and in two

**Garden and Forest*, v. 379 (A: g. 10. 1892.)

cases it had practically ruined the crop. This disease is probably due to a microbe, and it is therefore doubtful if spraying will be effective. Professor Halsted thinks that the same disease is one of the blights of the potato. Infected vines should be gathered and burned in the fall, and as a precautionary measure tomatoes or potatoes should not be grown upon the same land for two or three years.

18. *Impressions of Varieties.*—The Ignotum is still our best main-crop tomato.

Among the new kinds, a variety called Nichol No. 5, sent us by A. M. Nichol, Granville, Ohio, was the best. It is scarcely distinguishable from Mikado in foliage and fruit, except that the fruit is more regular and uniform in size.

Plentiful (Perry & Co.). A good red tomato, from medium to large in size, but inclined to crack about the stem. Appears to possess few superlative merits. An English variety.

Telegraph (*Salzer, 1891.*). A medium to small tomato, irregular, not uniform in size and shape; cracks very badly. A weak grower. Worthless with us.

Picture Rock (*Childs*). A good, dark red, regular tomato, much like the Volunteer, but apparently no improvement upon that variety. There is a slight tendency upon some fruits to assume yellow markings, in bars, about the stem.

Royal Red (*Livingston*). A good red tomato, showing a tendency to angular fruits, like those in cultivation some years ago. It reminds one of the Valencia Cluster, which was popular six and ten years ago.

Belmont (*Breck*). A promising, regular, red tomato, uniform, early and productive.

The following table shows the earliness and yields of these varieties :

TABLE XXIV.—VARIETIES.

Variety.	First picking.	Average no. fruits per plt.	Average crop per plant.
Nichol No. 5.....	Aug. 8.....	24.4	9.4 lbs.
Plentiful.....	Aug. 22.....	15	5.2 "
Telegraph.....	Aug. 22.....	32.7	6.7 "
Picture Rock.....	Aug. 8.....	23.2	6.4 "
Royal Red.....	Aug. 8.....	23.6	8.3 "
Belmont.....	Aug. 1.....	24.1	7.4 "

We tried no introductions this year which give promise of unusual merits. In order to determine the character of the varieties now prized in Germany, we sent to a leading seed firm there for the six best market varieties of tomatoes. The varieties received were Paragon, King Humbert, Yellow Plum, Earliest Dwarf, Monstrous Giant, and French Upright. Of these, only the Paragon would be considered of any value in America for market cultivation. The Earliest Dwarf and Monstrous Giant, which are second best, represent the old angular sorts which we have long since outgrown. A



German Striped Tomato.

singular German variety is that shown in the accompanying engraving, and which may be called the German Striped. It comes to us under the name of *Niedriche Gestreifte*, or "Low Striped." It belongs to the old angular type of tomatoes. The ground color is a deep clear red, and this is overlaid with splashes and bands of bright orange. Sometimes the orange is the prevailing color and the red takes the position of stripes. The fruit is very striking and its quality is also good. In general productiveness and merit it will probably rank fully as good as General Grant, which was popular a few years ago. We first grew this German Striped tomato in 1887. Striped or variously marked tomatoes occasionally appear in plantations, but this is the only one which we have ever known to be permanent, or to "come true to seed" for any length of time. A striped tomato appeared in an Ithaca garden three or four years ago, but it ran out in one or two generations.

The Currant-Ithaca hybrid which was described and figured

last year, was grown again this year from seeds and cuttings from one of the original plants. Among 36 plants, there were no reversions to either parent, although about one-third of them gave larger fruits than the others. All the plants were very productive and vigorous, and the fruit is very handsome.

SUMMARY.

1. *Quick and Slow Fertilizers.*—This year's experiments confirm those of last year in showing that tomatoes need a fertilizer which is quickly available early in the season. Fertilizers applied late or which give up their substance late in the season, give poor results because they delay fruitfulness and the plant is overtaken by frost before it yields a satisfactory crop. This fact is no doubt the origin of the wide spread opinion that the tomato crop is injured by heavy manuring. Nitrate of soda applied at once early in the season gave a much heavier yield than the same amount applied at intervals. (Page 189.)

2. *Value of Nitrate of Soda.*—Upon fairly good soil, which contains some vegetable matter, nitrate of soda gives good results as a tomato fertilizer. We have formerly found that upon very poor soils it gives little or no benefit. It must be remembered, however, that nitrate of soda is an incomplete fertilizer and that it should not be relied upon for a permanent treatment of land. It is simply a source of nitrogen. (Page 193, 196.)

3. *Relation of Variety to Fertilizing.*—In 1891 our test seemed to indicate that the highly improved varieties give the greatest response to fertilizing in the number of fruits produced, although the little improved sorts gave greater proportionate increase in total weight of crop. In 1892 these results were not verified, save that the little improved sorts gave least increase in number of fruits. But in the experiments of 1892 the test was made upon good soil, in which the results of fertilizing were obscured. (Page 196).

4. *Comparative Values of Early and Late Settings.*—Experiments this year confirm those of 1890 and 1891 in showing that very early planting in the field is advisable. Even those plants which were slightly injured by frost nearly equalled in produc-

tiveness those set at the general planting June 1. The late planting gave better results at the first pickings, however. Our earliest satisfactory setting this year was made May 9. (Page 197).

5. *Early and Late Seed Sowing*.—Tomato seeds were sown from January 19 to March 14. The earliest sowings gave the earliest fruits, but the largest yield came from the latest sowing, March 14, the difference in favor of this late sowing being very marked. In 1889 our tests showed that seeds sown in April and May gave poorer results than those started in March. It seems to be true, therefore, that the best time to sow tomato seeds in this latitude for the main crop, if one has a forcing-house or a good hot bed, is about the middle of March. (Page 200.)

6. *Few and Several Transplantings*.—Earlier fruits were obtained from plants which had been three times transplanted in the house than from those transplanted only once. In 1891, greater yields were obtained from two transplantings than from either one or three. Much, no doubt, depends upon the vigor and age of the plants, but it is certainly safe to say that in all ordinary cases plants which are started in March should be transplanted at least twice. (Page 202.)

7. *Flat-grown vs. Pot-grown Plants*.—Plants grown in pots, one lot transplanted twice and one lot thrice, gave earlier and heavier yields than plants similarly transplanted into "flats," or shallow gardener's boxes. (Page 202.)

8. *Seedlings vs. Cuttings*.—This year, cuttings gave earlier and heavier yields than seedling plants. In 1890, the cuttings gave the poorer yields, while in 1891 the results were mixed. These variations in results no doubt depend upon some condition of the plants or some factor in our handling which we have not yet discovered. Cuttings of cuttings gave better yields than one-generation cuttings, both last year and this. (Page 203.)

9. *Products of Early and Late fruits*.—Plants grown from seeds from the first ripe fruit upon a given plant gave poorer yields and no earlier fruits than other plants grown from a fruit from the same parent which ripened three and a half months later. Similar results have been obtained before by ourselves and others, and it is probably safe to say that no gain is secured by selecting seeds from early or first ripe fruits without giving any attention to the character or habit of the plant as a whole. (Page 205.)

10. *Products of Mature and Immature Fruits.*—Plants grown from seeds from a fully ripe fruit gave earlier and better yields than other plants raised from a fully grown but unripe fruit from the same parent. (Page 207.)

11. *Treatment of "Leggy" Plants.*—"Leggy" or "drawn" plants were set at the ordinary depth and half the stem was laid and covered in a shallow trench. These gave much larger yields than normal or stocky plants started and planted at the same time. Last year opposite results were obtained; but at that time the plants were so badly drawn that they were unable to stand alone. This year the leggy plants were about 20 inches high, but while slender they were still stiff and vigorous when put in the field. It is safe to conclude that if one has leggy plants he should layer them when planting. (Page 207.)

12. *Shearing Young Plants.*—Plants which were sheared to make them stocky, in the place of one transplanting, were later than others which were transplanted at the date of this shearing. The yields were slightly in favor of the sheared plants, but this may have been an incidental variation. (Page 208.)

13. *Hilling Tomatoes.*—Hilling tomato plants, during two years, has given no favorable results. (Page 209.)

14. *Trimming Tomato Plants.*—Trimming the plants after they have made a good growth in the field gave no advantage this year, and it is doubtful if it is advisable. (Page 209.)

15. *Single Stem Training.*—This year, as last, single-stem training in the field gave decidedly heavier yields to the square foot of land, and the crop was earlier. (Page 210.)

16. *Fruit-rot.*—Rot was not serious this year, and it did not appear to be influenced by methods of cultivation or varieties. (Page 211.)

17. *Southern or Field Blight.*—A new tomato disease appeared in our plantation this year. It is probably a bacterial trouble which may become serious. No remedy is known, but rotation of crop will probably check it. It is characterized by a yellowing, curling and drying of the leaves, which finally become black and dead. (Page 213.)

18. *Varieties.*—Few varieties were tested in 1892, and while they possess merit, none of them appear to be destined to supplant varieties already in existence. (Page 215.)

L. H. BAILEY,
L. C. CORBETT.

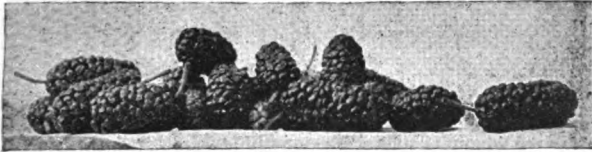
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HORTICULTURAL DIVISION.

MULBERRIES.



By L. H. BAILEY.

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38. The Cultivated Native Plums and Cherries.
39. Creaming and Aerating Milk.
40. Removing Tassels from Corn.
41. On the Comparative Merits of Steam and Hot Water for Greenhouse Heating.
42. Second Report upon Electro-Horticulture.
43. Some Troubles of Winter Tomatoes.
44. The Pear-Tree Psylla.
45. Tomatoes.
46. Mulberries.

MULBERRIES.

The mulberry is a neglected tree. It possesses decided value in ornamental planting, and some of the varieties are useful for hedges, shelter-belts and small timber. The fruit has merit for the dessert, and it is easily grown and is produced more or less continuously throughout a period of two to four months of every year. It is this value of the mulberry as a fruit-bearing tree which I particularly wish to discuss in this paper. Perhaps there is no immediate prospect that the mulberry can be grown with profit for the market because there is no demand for it, but it is capable of adding so much to the charm of the home garden and orchard that I desire to urge it upon the attention of every land owner. The botanical relationships of the various forms are also perplexed and they demand attention before any intelligent discussion can be made of their horticultural merits; but this subject is so difficult that I enter upon it with caution. No group of cultivated plants has bothered me more, and three years of study and collection of material appears only to have augmented the perplexities. Of all fruits cultivated in America, I think that none have so meagre a literature as the mulberries. There is an abundant record of the early attempts towards silk culture in this country and the mulberries which were grown for feeding the worms, but with the failure of these attempts the mulberry nearly passed from sight. There are men still living who remember the "multicaulis craze" of the thirties. Perrottet had introduced a new mulberry into France from the Phillipines in 1824, the large leaves and rapid growth of which at once attracted the attention of all silk-growers. It turned out that this tree had come originally from China and was the source of the famous Chinese silk. Perrottet called it *Morus multicaulis* from its habit

of branching or sprouting from the surface of the ground. This tree reached America in 1829 or 1830, by way of the nurseries of Messrs. Prince, on Long Island, and in 1830 or 1831 it was introduced into Massachusetts by William Kenrick, author of the "New American Orchardist." The fame of the tree spread rapidly, and there arose a fever of speculation such as has never been known in any other horticultural venture in America. The records of the next ten years read like fiction. Many nurserymen gave up all other business that they might grow the mulberry, and they realized several hundred per cent. profit. The secret of the Chinese silk had been discovered and every available acre from New England to the Gulf must be covered with the marvellous herbage of this mulberry, and men must train their hands to the breeding of the worms and spinning the silken threads! One nurseryman, who is still living, went to the West Indies that he might grow hundreds of thousands of trees during the winter season, so great was the haste for plants. From the thinly settled portions of the west the planters came eager for trees at almost any price, and even in Maine the demand was great. Then came the reaction. The market was supplied and soon over-stocked. A disease appeared. The winters of New England were too severe. One man near Hartford lost nearly ten thousand trees from cold. Men lost their fortunes; and in 1839 the bubble burst. One man near Philadelphia sold 250,000 trees at one auction in the fall of that year. He realized 31 cents each with a discount of $7\frac{1}{2}$ per cent. for cash. His buyers were mostly from the west. The eastern men had grown cautious before this. Other dealers sold for much less, and many had thousands of trees left upon their hands. "The trees were sold, in some instances, for a few cents each, and thousands, if not millions, were never replanted after they had been taken out of the ground in the fall of 1839." So *Morus multicaulis* passed from sight and the present generation knows nothing of it. No nurseryman grows it. The last specimen in the east, so far as any one knows, was cut down nearly ten years ago. It stood on the old battle ground at Germantown. Only one tangible result of this great contagion remains to us. Charles Downing, whose name will long remain a household word among those who love gardens and

fruits, planted seeds of this mulberry and raised the Downing Mulberry, which is now grown for its fruit.

This was not the beginning of American mulberry cultivation, although it was far the most important contribution to it. Before this time various forms of mulberries had been introduced, but mostly for the purpose of feeding silk worms. Benjamin Franklin had demonstrated that good silk can be grown in this country. M'Mahon, 1806, had urged the cultivation of the mulberry for fruit and for hedges as well as for silk. In 1806, too, Frederick Pursh, a botanical traveler, found mulberries cultivated in orchards near Cayuga Lake, N. Y., "may be for the raising of silkworms, as the trees were low and planted in regular close rows." William Prince, in 1828, regarded the Black Persian and the wild native red mulberry as the best for fruit, and he enumerates several kinds for silk. Among other sorts which were introduced in the early days was *Morus Tatarica*, which has lately reappeared as the Russian mulberry. So far, there appear to have been no varieties of any species of American origin. It is a significant fact that the first named variety originating in this country is an offspring of our own wild *Morus rubra*. This is the Johnson. The first mention of it, so far as I know, is in the first edition of Downing's "Fruits and Fruit Trees" in 1845.

I have said that the botany of the mulberries is perplexing. This is notoriously the case in every country where they are cultivated. There appear to be three well marked general types in cultivation, the white, black and red,—*Morus alba*, *M. nigra*, *M. rubra*. I must warn my readers that these names do not designate the color of the fruits of the respective species, although they were no doubt meant to distinguish them. Our native *Morus rubra* bears somewhat redder fruits than the others; fruits of the black mulberry are black, but so are those of the white mulberry in many cases. Perhaps we can apply the terms white and black in a general way to the color of the foliage, as that of *M. alba* is much lighter than that of *M. nigra*. The white mulberry is the species most used for silk. It has been cultivated in many countries for many centuries, and, as a consequence, it is wonderfully variable. Bureau, in his monograph of the genus in 1873, refers 31 described species to *M. alba* and recognizes 27

botanical varieties or types of it. But it is difficult, in some cases, to distinguish between *M. alba* and *M. nigra*, and if we are to follow Bureau's classification I do not see how the two can be kept apart, for some of the plants which he refers to *M. alba* seem to be as distinct from its type as *M. nigra* is. In this paper I have kept apart two species which are commonly referred to *Morus alba*. I do not know if they are distinct species, but they are more easily understood if they stand by themselves; and as species at best are only judgments of the particular author who describes them and not entities in nature, I may be allowed the present arrangement.

The later American mulberry culture for fruit, scant as it is, has developed along independent lines. The black mulberry, *Morus nigra*, is the fruit-bearing mulberry of history, and nearly all writers declare that the white mulberry possesses little or no value for fruit. Yet in America the black mulberry is almost unknown, except sparingly in the south and in California, and some of our common varieties are offspring of the white mulberry. And to these must be added varieties which I am satisfied belong to our native red mulberry.

The American mulberries, so far as I know them, may be grouped under the following species, omitting the kinds which were early cultivated for silk and are now practically unknown in the country:

1. The White Mulberry group.—*Morus alba*.
 1. (a). Russian mulberry.—Var. *Tatarica*.
 1. (b). Nervosa mulberry.—Var. *venosa*.
2. The Multicaulis group.—*Morus latifolia*
3. The Japanese group.—*Morus Japonica*.
4. The Black Mulberry group.—*Morus nigra*.
5. The Red or Native Mulberry group.—*Morus rubra*.
 5. (a) Lampasas mulberry.—Var. *tomentosa*.

1. THE WHITE MULBERRY GROUP.—(*Morus alba*, Linn.)
 Leaves light green, rather small, smooth or very nearly so above and often shining, the veins prominent beneath and whitish, variously lobed or divided, the basal lobes unequal, the teeth large and for the most part rounded or nearly obtuse, the branches gray or grayish-yellow. The white mulberry is supposed to be a na-

tive of China. It has been cultivated from the earliest times, chiefly for feeding the silk worm. It is a frequent tree along roadsides and in the old yards in the eastern states, where the trunk sometimes attains a diameter of two feet. This half-wild form usually has rather small rounded shining leaves with very large rounded teeth, and bears little whitish or violet fruits which are very sweet. Sometimes the fruits are an inch long, but they are oftener only half that length, and I sometimes find trees upon which the fruits are barely a quarter of an inch in length. Now and then a tree bears fruits nearly or quite black. Birds, poultry and hogs are fond of these mulberries. The trees are usually very thick-topped and bushy growers, but occasionally one is seen which, when young, has branches as straight and trim as a Northern Spy apple. These half-wild trees are seedlings, and this accounts for their variability. If the best ones were selected and grafted onto others, we might find trees worthy of orchard culture. This, evidently, has been done in some cases, for the three following named varieties differ from these half wild mulberries chiefly in their straighter growth, and larger and blacker fruit.

New American.—This variety was brought to notice by N. H. Lindley, Bridgeport, Conn., about 1854. No one knows its parentage. It is now widely cultivated, and it is the best mulberry yet known for the northern states. It is a strong, hardy tree, very productive, and bears continuously from late June until September. Large trees will produce ten bushels of fruit in a season. The fruit ranges from an inch to over two inches long, and it is glossy black when ripe. The accompanying picture shows a spray a little over half size. The fruit in this specimen is small. Notice the rounded teeth on the leaves, which are usually characteristic of these forms of *Morus alba*. The Downing has a greater reputation than any other variety, and this New American is often sold for it. In fact, the true Downing is now rare in cultivation. But this point will be discussed under the Downing, further on.

Trowbridge and Thorburn.—I do not know the origin of these mulberries. They are very like the New American, with a tendency, perhaps, towards a sharper toothing of the leaves. Some good judges declare that all three are alike, but I think that they are distinct. At least, I believe that the last two are

distinct from the New American. And there is some reason for supposing that Trowbridge and Thorburn are distinct. A party of botanists, to whom both varieties were new, were asked to pick and eat fruit from the two kinds last summer. They agreed



New American Mulberry.

that Trowbridge is slightly more acid than Thorburn and has more pronounced flavor. But so far as I know, these two varieties possess no merits above the New American and they are little known.

I. (a) THE RUSSIAN MULBERRY SUB-GROUP.—*Morus alba* var. *Tatarica*, Loudon. (*Morus Tatarica* of Linnæus).

This is a hardy type of *Morus alba* which was introduced into our Western States during 1875-'6-'7 by the Russian Mennonites. It scarcely differs from the type of *Morus alba* in botanical characters, and perhaps should not be kept distinct, even as a botanical variety. As common'y seen, it is a low-growing very bushy-

topped, small tree with small and much lobed leaves. The fruit is usually very small and insipid, and varies from creamy white to violet, deep red and almost black. The accompanying picture of the Russian Mulberry appeared in the *American Garden* some two years ago. It was made from a specimen taken early in the season from the Cornell garden.

The Russian Mulberry is commonly propagated from seeds and it is therefore very variable. A large-fruited or distinct-growing form often appears, and three, at least, of these have been named. They are described below.

The irritation which the Russian mulberry has produced reminds one of the *multicaulis* fever of sixty years ago, but it is far less serious and wide spread than that disease. This Russian mulberry has suffered from indiscriminate and exaggerated praise. Save an occasionable sport, it has no merit for fruit, unless it serves to attract birds from cherries and other fruits, but even this is a problematical advantage. In the east, at least, it has no merits for timber, as it is too small and grows too slowly. In the prairie soils of the west it often grows into respectable post timber in a short time. Mr. I. Horner, of Emporia, Kansas, writes as follows, concerning it :

"It has been said that this tree is only a bushy shrub. I here exhibit to you a section of a Russian mulberry tree five years old, and which has been grown in a shelter belt and overshadowed with cottonwood trees. It is five inches in diameter, and, as you see, a nice, straight and smooth trunk eight or nine feet

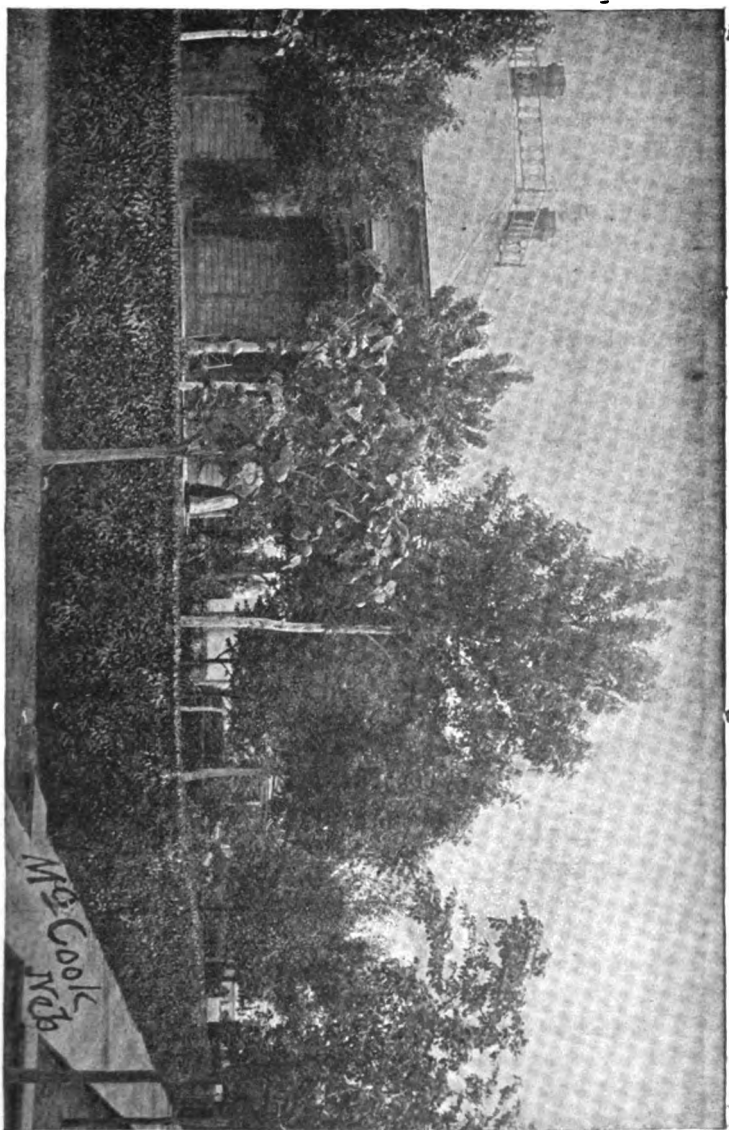


Russian Mulberry.

long. Another year's growth would make it suitable for posts. I measured one tree which gave a circumference of $37\frac{1}{2}$ inches at a point two and a half feet above the ground, and which was only eight years old. * * It is one of the very best trees for shelter belts and fence posts. From a hedge-row 15 rods long, I saw 200 nice fence posts cut. The wood is very durable. * * * *
 * It is a tree for fuel, shelter and posts for the western prairies." "There is a vast difference in character of growth and quality of fruit. Most trees sold by nurserymen have been grown from seed gathered from mulberry hedges and trees, with no regard to quality of tree, and which naturally generates a large per cent. of inferior stock. These may be known by a disposition to branch freely close to the ground, and a drooping inclination of their growth. They bear small notched leaves, and very small insipid fruit." "Shelter belts should be constructed in rows 12 to 16 feet apart, and the trees from two to four feet in the row. When three years old, cut all level with the ground. From their roots will spring up a strong and rapid growth of shoots. Remove all but the strongest to each tree. After two years, thin out as may be desired."

The Russian mulberry has been allowed by some land offices as a timber tree under the timber claim law.

But the chief merit of the Russian mulberry appears to be its value as a hedge plant in cold regions. Mr. Rosenberger of Nebraska makes the following note of it in a recent issue of *American Gardening*: "The Russian mulberry does not make a serviceable hedge to turn stock, but for an ornamental hedge there is nothing that I know of equal to it, at least for the west and northwest. It endures the extremes of climate better than any other plant or tree suitable for hedge purposes." This note is accompanied by an engraving, which is borrowed for this occasion, of a Russian mulberry hedge in Nebraska. Mr. G. J. Carpenter, secretary of the Nebraska State Horticultural Society and a prominent nurseryman, writes me as follows upon this point: "Russian mulberry hedges are found in nearly every town in Nebraska. It makes one of the finest ornamental hedges. The Mennonites, when they came to this country, planted a great many of them and used them to spread their clothing on to dry, and some of these hedges are 12 and 15 years old and in good condition



A Russian Mulberry Hedge at McCook, Nebraska.

yet. There are some very fine hedges in the western part of the state, west of the 100 meridian, that have been out for over eight years, and they are as perfect as any hedge can possibly be."

I think that the Russian Mulberry possesses considerable merit as a small ornamental tree and for the purpose of making low screens or shelter belts in the east. It is now largely used as a stock upon which to graft the named varieties of mulberry.

The named varieties or seedlings of the Russian type are three:

Victoria.—Originated in 1883, from seed of the Russian mulberry, by G. Onderdonk, of southern Texas. It is a tall and upright grower, bearing large sweet black fruit, which is in season for several weeks.

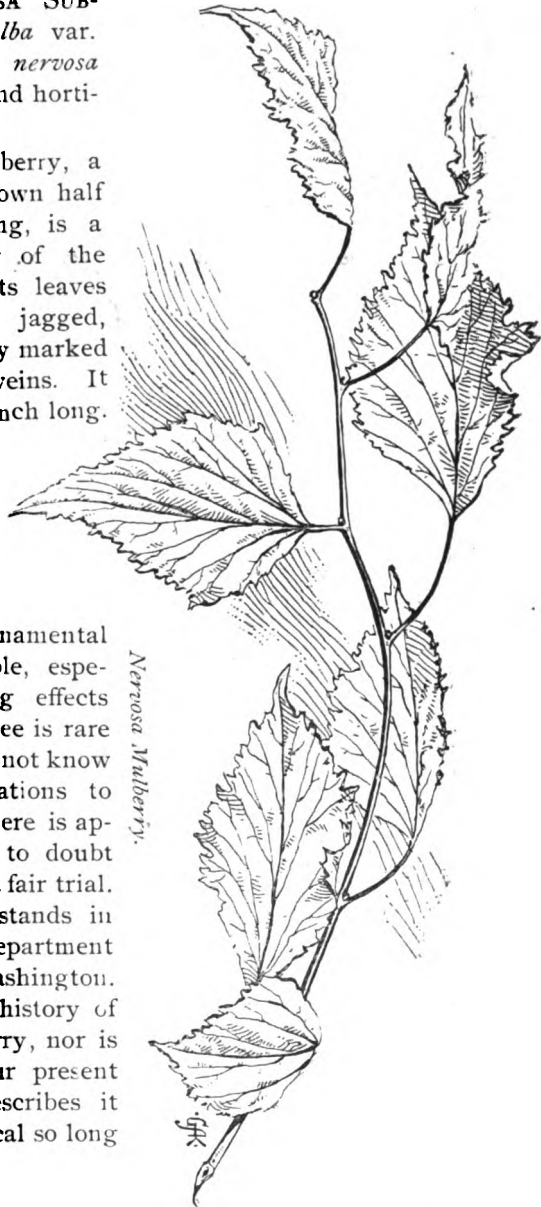
Mr. Onderdonk writes me as follows concerning it: "I named the Victoria after our county. It is proving itself of excellent quality, and is enormously productive. The more I see of it the more I am convinced that its dissemination is not a mistake. It has become very popular all over Texas, and as the Russian race of mulberries is hardy against every extreme of climate, I can see no reason why it should not spread over every part of the United States where the mulberry can exist. Whatever may be the merits of other varieties in other sections, the Victoria is their superior in this part of southern Texas."

Ramsey's White.—A white-fruited mulberry which came in a lot of Russian mulberry stock from Nebraska, purchased by Ramsey and Son, Mahomet, Texas, some ten years ago. Mr. Ramsey writes me that he has "concluded that it does not equal Hicks and two other varieties which we have." It is catalogued by Mr. Onderdonk, who says: "A good white mulberry, bears young; requires some pruning to make a good shaped tree. A desirable new sort."

Teas' Weeping Mulberry.—This, the most pronounced weeper among our ornamental trees, is a chance seedling of the Russian mulberry, having come up in a nursery row nine years ago in the plantation of John C. Teas, Carthage, Missouri. The original seedling tree is still only three feet high, although vigorous. In the nursery row this seedling trailed on the ground, while all the others made the ordinary upright growth. Grafted head high upon vigorous Russian stocks, it makes a most striking lawn tree. The branches curve outwards for a foot or two and then fall straight downward to the ground.

1 (b) THE NERVOSA SUB-GROUP.—*Morus alba* var. *venosa*, Delile. (*M. nervosa* of Bon Jardinier and horticulturists).

The Nervosa mulberry, a spray of which is shown half size in the engraving, is a strange monstrosity of the white mulberry. Its leaves are contracted and jagged, and are very strongly marked with many white veins. It bears a fruit a half inch long. Among the horticultural curiosities, this tree should find a place, and it is to be regretted that it is not grown by our nurserymen. Its ornamental value is considerable, especially when striking effects are desired. This tree is rare in America, and I do not know what are its adaptations to our climates, but there is apparently no reason to doubt its success if given a fair trial. A large specimen stands in the grounds of the Department of Agriculture at Washington. I do not know the history of the Nervosa mulberry, nor is it important for our present purpose. Delile describes it in a French periodical so long ago as 1826.



Nervosa Mulberry.

2. THE MULTICAULIS GROUP.—*Morus latifolia*, Poiret. (*M. multicaulis* of Perrottet. *M. alba* var. *multicaulis* of London.)

A strong growing small tree or giant shrub, with dull, roughish and very large long-pointed leaves which are seldom or never prominently lobed, and which are often convex above, bearing black sweet fruit. I have already given a sketch of *Morus multicaulis* in America. Its most prominent offspring is the

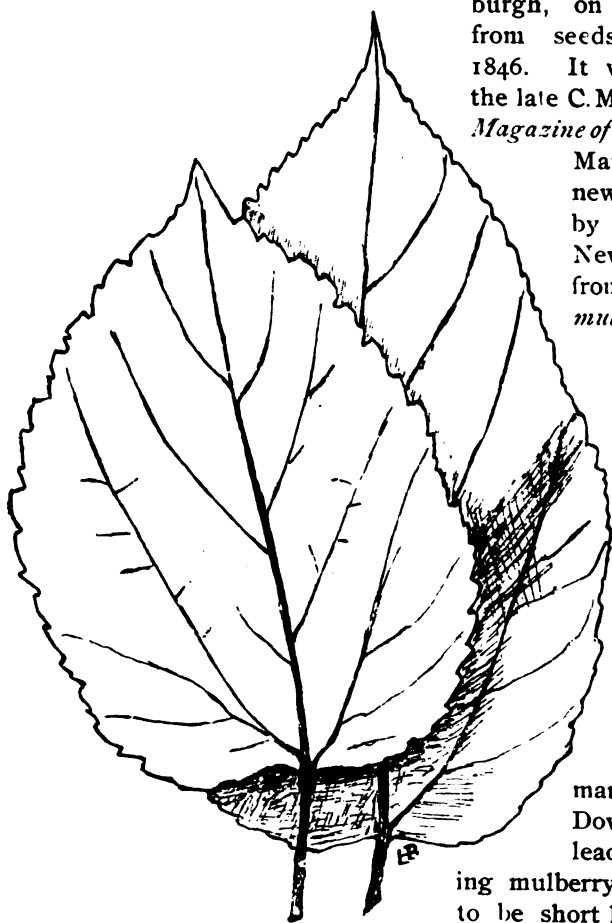
Downing (*Downing's Everbearing*).—This originated at Newburgh, on the Hudson, from seeds sown about 1846. It was noticed by the late C.M. Hovey in his *Magazine of Horticulture* in

March, 1858, as "a new seedling raised by C. Downing of Newburgh, N. Y., from the *Morus multicaulis*." The

Downing often looks very different from the old multicaulis, and I sometimes doubt if its history is correct; but there is probably no doubt as to its origin. For

many years the Downing was the leading fruit-bearing

mulberry, but it proved to be short lived and was



New American and Downing Leaves.

often injured by the winters in the northern states ; and even as far south as Texas it frequently suffers from the cold. In Florida it is said to be still popular. The Downing now sold by most nurserymen is the New American, as I have already said. Only the older nurseries still grow the true Downing, so far as I have observed in the eastern states. Most planters and perhaps some nurserymen are not aware of this substitution. Some nurserymen habitually substitute the New American for the Downing, using the latter name, saying that they are disseminating a better variety. It is true that the New American is the better of the two, at least for the north, but it is unfortunate that this substitution should have occurred. Many nurserymen suppose that the two varieties are the same, but they not only differ in hardiness but also in foliage and fruit. The accompanying outlines show some of the difference in foliage. The top leaf is the New American and the under one Downing. The Downing leaf is much the larger and longer, longer-pointed, with smaller teeth. It is usually proportionally larger than shown in the engraving. It is also a duller and usually a thinner leaf than that of the New American. By referring to the first illustration in this paper, it will be seen that the fruit of the New American is made up of closely compacted parts or drupelets, while in the Downing, as seen in the cut in the margin, the drupelets are more or less detached. This picture of the Downing fruit shows a small specimen. The fruit is black, of excellent quality, possessing a slight acidity which is apt to be lacking in the varieties of *Morus alba*. The fruit ripens from June until September.



Downing.

Spalding.—I am indebted to T. V. Munson of Denison, Texas, for a knowledge of this variety. It is said to be a seedling of the Downing, and the leaves and habit confirm this origin. Mr. Munson says that it is as tender as the Downing. It originated with the late E. H. Spalding, who thought it the finest variety in cultivation. I do not know its fruit.

Rives.—This mulberry, which is sent me by G. Onderdonk, of Nursery, Texas, was found upon the promises of James Rives of Mission Valley, Victoria Co., Texas. Its origin is unknown.

Mr. Onderdonk thinks it is a form of *Morus Japonica*, but it seems to me to belong to the multicaulis group, although it may be the native *Morus rubra*. I have not had an opportunity to study it thoroughly. "The fruit, while being good, has not special merit," Mr. Onderdonk says. It is recommended chiefly for shade, the growth being very rapid and the leaves large. It is also said to be valuable for silk. In Texas it blooms so early that the fruit is often lost.

Two mulberries have recently been sent me from the University of California under the name of Lhou—originally spelled Lhou—and Nagasaki. These, I think, belong with the multicaulis group, although they suggest *Morus Japonica*. Bureau refers some of the Chinese Lhou mulberry to *Morus alba* var. *macrophylla* (*Morus Moretti*), and some of it to this multicaulis group. At the University of California the climate is said to be too cold to allow these mulberries to fruit. These oriental varieties are grown chiefly for feeding silk worms.

3. THE JAPANESE GROUP.—*Morus Japonica*, Audibert.—(*M. alba* var. *stylosa* of Bureau.)

Leaves usually large, dull, rather thin, long-pointed, the rounded teeth very large and deep, or the margin even almost jagged, the leaves upon the young growth usually deeply lobed. This species has been introduced very lately and it has not yet fruited in this country, so far as I know. It is tender in the north when young. The fruit is described as short-oblong and red.

4. THE BLACK MULBERRY GROUP.—*Morus nigra*, Linn.

Leaves dark dull green, rather large, tapering into a prominent point, commonly very rough above, usually not lobed, the base equal or very nearly so upon both sides, the teeth rather small and close, the branches brown. The black mulberry is a native of Asia, probably of Persia and adjacent regions. It is the species which is cultivated in the Old World for its fruit. In America it is very little grown. It is not hardy, except in protected places, in New England and New York. The Black Persian mulberry of the south and of California is undoubtedly this species. This variety, with others, was inserted in the Fruit Catalogue of the American Pomological Society for 1875. It was dropped

Wild Red Mulberry—Morus rubra.
Half size.



from the Catalogue in 1883, and has not been inserted since. It is named in Wickson's "California Fruits," 1889, without particular comment. The same volume also mentions the Black mulberry of Spain, as having been fruited by Felix Gillet, of Nevada City, California. This I take to be *Morus nigra*. There must be large regions in this country which are congenial to the true black mulberry, and it is strange that it is so little known. The fruit of this species is much larger than that of any other, and it possesses an agreeable sub-acid flavor. The fruits of *Morus alba*, however, are often too sweet for most tastes when fully ripe, and in such case they should be picked before they have fully matured.

5. THE RED OR NATIVE MULBERRY GROUP.—*Morus rubra*.
Linn.

Leaves usually large, very various, those on the young shoots deeply lobed with very oblique and rounded sinuses in the base of which there are no teeth, the upper surface rough and the lower one soft or variously pubescent, the teeth medium or comparatively small and either rounded or bluntish. The native mulberry is generally distributed from western New England to Nebraska and southward to the Gulf, being much more abundant and attaining a larger size in the south. The fruit is deep red, or when fully ripe, almost black, variable in size, often very good, nearly always having an agreeable slight acidity. This native mulberry has been tried for the feeding of silk-worms, but with indifferent success. I am satisfied that at least three of the named fruit-bearing mulberries belong to it, and a yellow-leaved mulberry, which is somewhat grown for ornament, also appears to be of this species. The curious lobing of the leaves on the young growth is shown in the middle spray in the accompanying engraving (page 237). This lobing is distinct from that in any other mulberry which I have seen, and it has been one of the chief characters in influencing me to refer the Hicks and Stubbs mulberries to *Morus rubra*. The nearest approach to this lobing which I have seen in any other mulberry is in the Japanese (*Morus japonica*) and this affords another of those interesting parallelisms which exist between the Japanese and eastern American floras. The red mulberry is the largest tree of the genus. It often attains a height of 70 feet in the south. The timber is

much used for posts, fencing and light wood-work. The two accompanying pictures are made from wild specimens collected in Michigan.

Johnson.—I have already said that this appears to have been the first named variety of mulberry, of any species, originating upon American soil. The first record of it, so far as I know, is in the first edition of A. J. Downing's "Fruits and Fruit Trees," 1845, in which it is said that the variety has been "lately received from Professor Kirtland, of Cleveland, one of the most intelligent horticulturists in the country;" and it is distinctly stated that it is a form of our native species. Charles Downing re-



Wild red mulberry. Full size.

affirms this latter statement in Purdy's *Fruit Recorder*, in 1872, and in comparing the fruit with that of the wild *Morus rubra* says that it is "of about the same quality, but of larger size." In the second edition of "Fruits and Fruit Trees," 1872, by Charles Downing, it is described as follows: "A seedling from Ohio. Fruit very large, oblong cylindric; blackish color, sub-acid and or mild agreeable flavor. Growth of the wood strong and irregular. Leaves uncommonly large." The Johnson is very little known at the present time and will probably soon pass from sight. Mr. Berckmans, of Georgia, writes that the "fruit is large, very good, but too little of it," and that he has "long since discarded it." "The fruit is fully two inches long by three-fourths inch in diameter, very black and of a rich vinous flavor."

Hicks (Hicks' Everbearing). This is a Georgian variety, as near as I can learn, although Downing, in 1872, credits it to Kentucky. It was brought to notice about 1850, or before, by Simri Rose, of Macon, Georgia, who is said to have obtained it from Thomas Elkins, of Effingham Co., Georgia. Mr. Elkins "planted it in avenues, on his lanes, in his fence corners, and many other favorite places on his plantation, for his hogs, and it is said that he always had pork or bacon to sell." At the present time it is much used in parts of the south as a food for swine. Mr. Berckmans says that "the value of mulberries as an economic food for hogs is beginning to be appreciated by many farmers, who have

planted large orchards of the Hicks for that purpose." It is also one of the very best varieties for poultry. It is a most profuse bearer, producing a continuous and bountiful crop for three and four months. The fruit is medium to large, very sweet and rather insipid.

Stubbs.—The original Stubbs mulberry tree was found growing in a wood near Dublin, Laurens Co., Georgia. Col. John M. Stubbs, of that place, gave cions to Mr. Berckmans some 15 years ago, and Mr. Berckmans introduced it to the public. It is probably the most productive of all mulberries, even exceeding the wonderful prolificacy of the Hicks. The fruit is deep black, with a very rich sub-acid vinous flavor. It is fully two inches long and over a quarter as thick in well developed specimens.

5. (a) THE LAMPASAS SUB-GROUP.—*Morus rubra* var. *tomentosa* Bureau. (*M. tomentosa* of Rafinesque.)

Leaves very soft-pubescent and whitish beneath, often glossy but rough above.

Lampasas.—This variety was found in the woods in Lampasas County, Texas, by F. M. Ramsey, and was introduced in 1889 by T. V. Munson, of Denison, Texas. It has a somewhat spreading and shrub-like habit. Mr. Munson writes as follows concerning it: "The Lampasas mulberry, although a native of the region only 200 miles southwest of here, is so tender here as to winter kill. I have ceased to propagate it on that account. I have never been able to fruit it."

There are three varieties of fruit-bearing mulberries which I have not seen, and I do not know to what species they should be referred. One is *Bigert* (*Bigert's Everbearing*), which I know only from the following note in the first volume of *Gardener's Monthly*, 1859: "A friend sends us some specimens under the above name, which he says continues in bearing from June till frost. It is very much in size and appearance like Downing's Everbearing, but the leaves are very different."

Another variety is the Paine, which, I think, has not been mentioned in print. All I know about it is the following description sent me by the venerable Isaac Hicks, of Westbury, Long Island: "Fruit about the size of Downing, not so large as New American. A very excellent variety, bearing a long time.

Found on the lot where Thomes Paine, the religious reformer, was buried. Two very fine trees, which are great bearers, are on the place of the late Wm. S. Carpenter, at Marmaroneck, Westchester Co., N. Y."

The third variety is the Black American, which I know only from the following entry in the catalogue of the Bloomington (Illinois) Nursery: "Native, hardy, productive, valuable."

The cultivation of the mulberry is very simple. It thrives upon any ordinary well-drained soil. At full maturity, the trees are as large as an apple tree. The fruit falls as soon as it is ripe, and it is readily shaken off before it reaches its full maturity. If a soft sod is allowed under the tree, the fruit can be shaken off and picked from the ground. This is the best way of harvesting the mulberry. In Europe, cress is sometimes sown under the trees in late spring to afford a temporary carpet to catch the fruit.

The mulberries can be propagated by cuttings of the ripe wood or of roots. Cuttings start best under glass. Some nurserymen propagate by short cuttings indoors, starting them in February or March. The cheap Russian mulberry stocks, from the west, have supplanted cutting-propagation very largely. The named sorts are grafted upon these Russian roots in winter, with fair success, in the same manner in which apple trees are root-grafted, or they are sometimes crown-grafted, the stocks for this purpose being grown in pots or boxes. Ordinary fall budding in the field is not successful with mulberries, but spring budding gives good results. Spring budding has been employed and recommended certainly for thirty years, but it does not yet appear to be a common practice. S. D. Willard, Geneva, N. Y., who grows quantities of mulberries, has several times shown me his stock, which is propagated by spring coin-budding. This is performed just before the foliage is out, or as soon as the bark slips freely. The illustration in the margin explains the operation. The incision in the stock is the same as for the ordinary fall budding. The coin carries one or two buds, and is cut upon one side only. This prepared side is inserted next the wood in the stock, and is held in place by string, as for fall budding.



*Coin-budding for
the mulberry*

REVIEW.

1. The mulberry is grown for fruit, ornament, hedges and small timber, as well as for silk. It merits more general attention, especially as a fruit-bearing tree.

2. The fruit of some varieties is excellent for dessert, and it may be used for making jellies and preserves. It is also good food for poultry and for swine.

3. Sixteen varieties are mentioned in this paper as fruit-bearing kinds: New American, Trowbridge, Thorburn, Victoria, Ramsey's White, Downing, Spalding, Black Persian, Black Spanish, Johnson, Hicks, Stubbs, Lampasas, Bigert, Paine and Black American. Of these, the most prominent are New American, Downing, Black Persian, Hicks, Stubbs.

4. The New American is recommended for the northern states. Downing is almost out of cultivation in the north, but the New American commonly passes under this name. Black Persian is occasionally grown in the south and on the Pacific coast, but it seems to be ill-adapted to our conditions. Hicks is a heavy bearer, of indifferent quality, but valuable for poultry and for swine, especially in the south where it has been most thoroughly tested. Stubbs is perhaps the most profuse bearer of all, and the fruit is large and excellent in quality.

5. The other varieties and types are grown for shade, ornament and timber. The most unique of these varieties are the Nervosa and Teas' Weeping. The Russian type is valuable for ornamental hedges, especially in the prairie states, for planting sparingly as single specimens or in groups as ornamental trees, and for small timber on the prairies. The fruit is usually worthless. This type has already given three named varieties of more or less merit,—Victoria, Ramsey's White, and Teas' Weeping.

6. The mulberries here enumerated belong to five more or less distinct general types or species,—*Morus alba*, *M. latifolia*, *M. Japonica*, *M. nigra*, and *M. rubra*. The first and the last are the most important in this country for the purposes here discussed.

7. American varieties of fruit-bearing mulberries have developed along independent lines, having come chiefly from *Morus alba* and *M. rubra*, while the fruit mulberry of history is *M. nigra*.

8. The native mulberry, *Morus rubra*, has given us some of the most important varieties, and as it is naturally variable and adapted to our various climates, it is the probable progenitor of the American mulberries of the future.

9. The mulberry is easily grown upon ordinary soils. It is often tender in the north during the first two or three years.

10. The mulberry is propagated by cuttings of the mature wood or the roots, by root and crown-grafting, and by budding with dormant buds in the spring.

L. H. BAILEY.

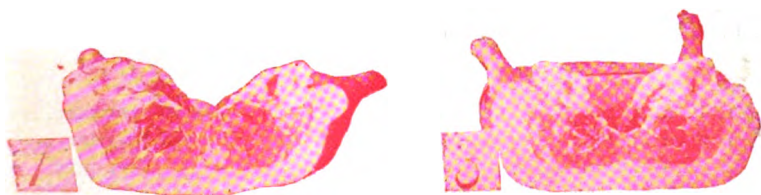
Bulletin 47.

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Cornell University Agricultural Experiment Station

AGRICULTURAL DIVISION.

FEEDING LAMBS AND PIGS.



By I. P. ROBERTS

AND

GEO. C. WATSON.

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Those desiring this Bulletin sent to friends will please send us the names of the parties.

BULLETINS OF 1892.

38. The Cultivated Native Plums and Cherries.
39. Creaming and Aerating Milk.
40. Removing Tassels from Corn.
41. On the Comparative Merits of Steam and Hot Water for Greenhouse Heating.
42. Second Report upon Electro-Horticulture.
43. Some Troubles of Winter Tomatoes.
44. The Pear-Tree Psylla.
45. Tomatoes.
46. Mulberries.
47. Feeding Lambs and Pigs.

FEEDING ENSILAGE TO LAMBS.

A flock of ten grade Shropshire lambs, about eight months old, was selected for this experiment and divided into two lots of five each. These lambs were thrifty, quite uniform in size and general appearance, and when divided each lot was of nearly the same total weight, and contained three wethers and two ewes.

To lot I, was given ensilage, hay, and a grain ration, consisting of one part of linseed meal, two parts cotton seed meal, and four parts wheat bran by weight. To lot II, was given hay, and the same grain ration as to lot I. The hay was mixed, mostly clover; the ensilage was made from Pride of the North corn grown in check rows and carrying a good crop of ears.

At the beginning of the experiment, December 8th, grain was fed only in the morning, but on and after December 31st grain was fed both morning and evening.

The following tables show the weights and gain of each individual lamb during the experiment, and also the totals for the whole experiment.

TABLE I.—LOT I—ENSILAGE.

Weight in pounds.

Ear mark No.	169.	174.	176.	177.	178.	Total.
Date, Dec. 8.	62.5	57.5	60.5	61.5	53.5	295.5
Jan. 5.	65	64.5	62.5	63.5	56.5	312
Feb. 11.	74	73	68.5	69.5	61.5	346.5
Mch. 28.	85.5	86	86	81	71	409.5
Apr. 27.	96	87.5	90.5	80.5	73.5	428
Gain.	33.5	30	30	19	20	132.5
Average gain per head.						26.5

TABLE II.—LOT II—DRY FOOD.
Weight in pounds.

Ear mark No	170.	171.	172.	173.	175.	Total.
Date, Dec. 8	52.5	62	66	58	61	299.5
Jan. 5	56	65	67	62	65	315
Feb. 11	62.5	71	73.5	68.5	70	345.5
Mch. 28	72	85.5	88	79.5	79	404
Apr. 27	71	90	93.5	79	90	423.5
Gain	18.5	28	27.5	21	29	124
Average gain per head						24.8

The following tables show the number of pounds of food consumed, the amount of water drank, and the total water consumed by each lot.

TABLE III.—LOT I—ENSILAGE.

	Pounds	Dry Matter, Pounds.	Water, Pounds.
Wheat bran	382.6	335.3	47.3
Cotton seed meal	191.3	175.4	15.9
Linseed meal	95.6	86.8	8.8
Hay	606	525.3	80.7
Ensilage	1166	246.5	919.5
Water drank			2117.75
Total pounds consumed	2441.5	1369.3	3189.95

TABLE IV.—LOT II—DRY FOOD.

	Pounds.	Dry Matter, Pounds.	Water, Pounds.
Wheat bran	387.4	339.5	47.9
Cotton seed meal	193.7	177.6	16.1
Linseed meal	96.9	88	8.9
Hay	905.25	784.6	120.65
Water drank			2672.00
Total pounds consumed	1593.25	1389.8	2865.55

It will be observed from tables I and II that the gain of these two lots of lambs was very uniform, and that the total gain was

practically the same, so that any deductions we may draw from the experiment will come from comparing the cost of food consumed by the two lots, rather than any marked difference in growth or weight.

By referring to tables III and IV it is seen that the total amount of dry matter consumed by the two lots was practically the same, while the amount of water drank or consumed varies considerably. The lot fed wholly on dry food drank 555 lbs. more water during the experiment, than did the lot fed ensilage, while the total water consumed in food and drink by the ensilage fed lot was 324 lbs. more than that consumed by the lot fed wholly on dry food. By the water consumed is meant not only the water drank but the water contained in the food as well. This is found in the third column of tables III and IV.

As the grain ration fed these two lots as well as their gain was practically the same, it may be seen from tables III and IV that the ensilage seemed to take the place of a part of the hay. Lot I ate 1166 pounds of ensilage and 606 pounds of hay, Lot II ate no ensilage and 906 pounds of hay, therefore the 1166 pounds of ensilage took the place of 300 lbs. of hay or about four pounds of ensilage to one of hay. As a matter of economy the ensilage was a cheaper food than the hay in this experiment; since the cost of 1166 lbs. of ensilage is much less than the cost of 300 lbs. of hay. To carry the comparison still further, assuming as a basis a yield of two tons of hay per acre, would require as an equivalent a yield of less than eight tons of ensilage per acre. As a matter of fact our land that produces two tons of hay yields from twelve to sixteen tons of ensilage, per acre. Or the comparison may be made in still another way: if hay costs ten dollars per ton the ensilage in this experiment had a feeding value of more than two and one-half dollars per ton.

NITROGENOUS AND CARBONACEOUS RATIONS FOR LAMBS.

From a flock of twenty-seven grade Shropshire lambs, $\frac{3}{4}$ about eight months old, eighteen were selected for experimental feeding and divided into two lots of nine each. Although quite thin in flesh at the time of commencing the experiment, these lambs were thrifty and remained hearty and vigorous throughout the winter. They were sheared at the beginning of the experiment and placed in warm comfortable quarters in the University barn where the temperature seldom fell below the freezing point, even during the most severe winter weather.

The experiment was begun Nov. 15 and continued to Feb. 26. To lot I was fed hay, turnips and a grain ration of corn, 7 parts, and oats, 1 part. To lot II was fed hay, turnips and a grain ration of linseed meal, 3 parts, and wheat bran, 2 parts, for the morning feed; and for the evening feed cotton seed meal, 3 parts, and wheat bran, 2 parts.

The following tables will show the weights of the individuals at the beginning and at different periods during the experiment; also the gain for each individual and the total for the lot at the end of the experiment.

TABLE V.—LOT I—CARBONACEOUS.

Weight in pounds.

Ear Mark No.	110	113	114	96	103	104	101	95	111	Total
Weight Nov. 15.....	52	61	59	49	57	51	53	54	65	501
“ “ 28.....	54	64	62	50	63	53	55	59	67	527
“ Dec. 23.....	58	73	68	51	56	58	59	67	71	561
“ Jan. 23.....	71	82	79	55	61	51	66	75	82	632
“ Feb. 12.....	77.5	88	85.5	54.5	65	64	71	77.5	88	671
“ “ 26.....	85	90	90	56	66	67	74	82	93	703
Gain	33	29	31	7	9	16	21	28	28	202
Average gain per head.....										22.5

TABLE VI.—LOT II—NITROGENOUS.

Weight in pounds.

Ear Mark No.	116	115	112	100	105	97	106	85	83	Total
Weight Nov. 15.....	62	52	62	57	48	53	54	62	53	503
“ “ 28.....	63	55	65	60	49	54	59	65	58	528
“ Dec. 23.....	70	61.5	67	61.5	52	56	68	74	64	574
“ Jan. 23.....	81	77	77	71	57	71	77	83	67	661
“ Feb. 12.....	83	82.5	82	80	62.5	71	85	85	73.5	704
“ “ 26.....	88.5	92	86	78.5	66.5	78.5	89	91	78.5	748.5
Gain.....	26.5	40	24	21.5	18.5	25.5	35	29	25.5	245.5
Average gain per head.....	24.5									

Tables VII and VIII show the food consumed and the water drank for each lot during one hundred and three days, the time of the experiment.

TABLE VII.—LOT I—CARBONACEOUS.

Food consumed.	Lbs.	Dry Matter. Lbs.
Hay.....	982.	851.
Corn.....	831.	742.
Oats.....	119.	106.
Roots.....	1012.	80.
Water drank.....	1020.25	

The above foods gave of digestible constituents a nutritive ratio of 1 to 8.4.*

TABLE VIII.—LOT II—NITROGENOUS.

Food consumed.	Lbs.	Dry Matter. Lbs.
Hay.....	1330.	1152.
Bran.....	447.	391.
Linseed meal.....	335	305.
Cotton seed meal.....	336.	308.
Roots.....	1292.	102.
Water drank.....	2203.	

* The nutritive ratio is obtained by adding the carbohydrates, or nitrogen free extract and fiber, to $2\frac{1}{2}$ times the fat and dividing by the albuminoids or protein.

This ration gave of digestible constituents a nutritive ratio of 1 to 3.5.

It may be seen from Tables VII and VIII that the lot fed the nitrogenous or narrower ration consumed 348 lbs., or about 35 per cent., more of hay and 168 lbs., or about 17 per cent., more of grain. As each lot received all the hay and grain they would readily consume, it is apparent that the greater consumption of food and the greater increase in live weight of Lot II was due to the difference in the ration, for at the beginning the total live weight of each lot was very nearly the same, and the two lots were of the same apparent vigor and healthfulness. Not only did Lot II consume about 27 per cent. more dry substance, but the quantity of water drank was more than twice as much as that drank by Lot I.

The gain in live weight of Lot II over Lot I was about 21 per cent., and this very nearly represents the amount of dry substance consumed over that consumed by Lot I.

It will be observed from Tables V and VI that the gain of the individuals of Lot II were much more uniform than the gain of the individuals of Lot I. This condition has frequently been observed in experimental feeding at this Station, that where nitrogenous and carbonaceous rations have been compared, the gain of individuals of the nitrogenous lots has been more uniform; this may be only a coincidence and not a law, but the results of experiments already made will warrant a closer observation concerning this point in future investigations. Although the results of this experiment give no marked difference in gain of one lot over the other, the results obtained may be of value to the feeder to give some definite figures concerning the gain from the food consumed. Table IX gives a summary of foods consumed and gain in live weight obtained.

TABLE IX.

	Lot I.		Lot II.	
	Total weight.	Dry substance.	Total weight.	Dry substance.
Grain.....	950.	848.	1118.	1004.
Hay.....	982.	851.	1330.	1152.
Roots.....	1012.	80.15	1292.	102.
Total.....	2044	1788.91	3740.	2258.
Total gain.....	202.		245.5	
Pounds of grain to one pound of gain.....	4.7		4.9	
Pounds of hay to one pound of gain.....	4.7		4.6	
Pounds of dry substance to one pound of gain.....		8.8		9.2

NITROGENOUS AND CARBONACEOUS RATIONS FOR PIGS.

December 23, four Poland China pigs were selected from the University herd and divided into two lots of two each for experimental feeding, to make a test of the difference between a comparatively wide or carbonaceous ration and a narrow or nitrogenous one.

The pigs at the beginning of the experiment were quite uniform in size and individual appearance, and by referring to table XII it may be seen that the difference in weights of the two lots was less than five pounds. The pigs of these two lots were all barrows from the same breeding, and had received the same care and food until the time they were selected for this experiment.

During the entire experiment, of 125 days, 837 pounds of corn meal and 60 pounds of skim milk was fed to lot I.

580 pounds of corn meal, 300 pounds of meat scrap and 540 pounds of skim milk was fed to lot II.

Tables X and XI give the digestible constituents of the two rations, and also the nutritive ratio.

TABLE X.—LOT I—CARBONACEOUS RATION.

	Lbs consumed.	Digestible.			
		Protein.	Nitrogen free-extract.	Fiber.	Fat.
Corn meal.....	837	72.21	507.55	12.19	57.19
Skim milk.....	60	2.58	2.52		.30

Nutritive ratio, 1 to 8.9.

TABLE XI.—LOT II—NITROGENOUS RATION.

	Lbs consumed.	Digestible.			
		Protein.	Nitrogen free-extract.	Fiber.	Fat.
Corn meal.....	580	50.04	351.71	8.99	39.63
Meat scrap.....	300	154.58			51.19
Skim milk.....	545	23.44	22.89		2.73

Nutritive ratio, 1 to 2.8.

During the whole time of feeding there was no time when any animal did not readily consume its ration, and the gain in weight was rapid and uniform. Table XII gives the total weights of the two lots at different periods during the experiment; also the total gain and the gain per day for each lot.

TABLE XII.

	Lot 1.	Lot 2.
Dec. 23.....	123 lbs.	118.5 lbs.
Jan. 21.....	176.5 "	168 "
Mar. 7.....	281 "	257 "
Apr. 7.....	377 "	359 "
Apr. 27.....	429 "	438 "
Total gain.....	306 "	319.5 "
Gain per head per day.....	1.22"	1.27 "

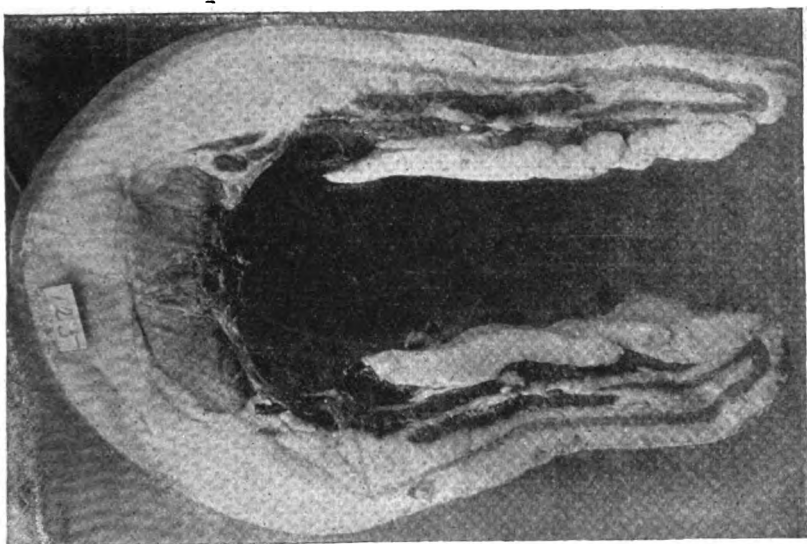
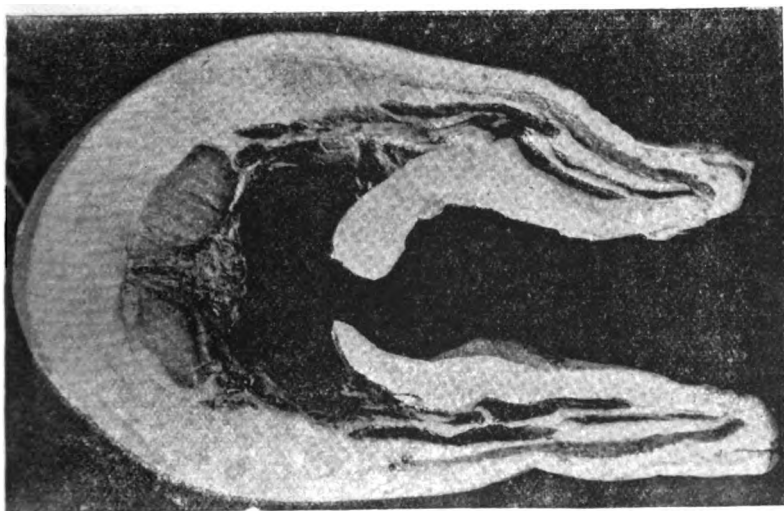


FIG. 1.—*Lot I—Carbonaceous.*



Lot II—Nitrogenous.

Since these two lots, fed on widely differing rations, had made so good a growth, about one and one-fourth pounds per day, per animal, during the entire experiment, and were so nearly alike in total weight and general appearance, it was thought best to ascertain if there was any marked difference in the composition of meat from the animals of the two lots. Accordingly a section was taken from the carcass of each hog between the eleventh and thirteenth ribs. These sections were skinned, the bone removed, and then run through a sausage cutter, thoroughly mixed and samples taken to the chemist for analysis.

Table XIII gives the results of the analysis for each sample.

TABLE XIII.

Ear mark No.	Lot 1.		Lot 2.	
	125	126	121	122
Water	23.47%	22.63%	26.17%	22.91%
Protein (lean meat).....	7.62%	8.00%	8.37%	8.00%
Fat	67.15%	67.44%	63.43%	66.63%
Ash	1.76%	1.72%	2.03%	2.16%

It will be observed from table XIII that the difference in protein of the two lots is no greater than that in individuals of the same lot, so that in this case the wide difference in the rations of the two lots did not produce a marked difference in growth of the animals or of chemical composition of the meat,

Figure one shows a reproduction from photographs taken from a cross-section between the eleventh and twelfth ribs of one individual of each lot. These sections also show that there was no marked difference in the amount or distribution of lean and fat meat of the two animals.

Table XIV gives the weight of each animal at the close of the experiment and also the dressed weight and weight of internal organs.

TABLE XIV.

	Lot 1.				Lot 2.			
Ear mark No.	125		126		121		122	
	lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.
Live weight.....	218		211		214		224	
Wt. after bleeding..	212		207		208		217	
Wt. of blood.....	6		4		6		7	
Wt. of heart.....		8		6		9.5		8
Wt. of lungs.....	1	3	1	3.5	1	6	1	
Wt. of liver.....	2	14	2	13.5	4	13	4	5
Wt. of spleen....		5		3.5		4		5
Wt. of caul fat.....	1		1	1.5		10.5		—
Wt. of viscera.....	15	8	—	—	—	—	22	4
Dressed weight.....	184		—	—	—	—	185	

It will be seen that the only marked difference in the internal organs is that the livers of the nitrogenous lot were nearly twice as heavy as those of the carbonaceous lot.

The pigs fed in this experiment were of the same lot and breeding as the dams of the pigs of the succeeding experiment.

NITROGENOUS AND CARBONACEOUS RATIONS FOR PIGS. SECOND GENERATION.

Four Poland China pigs about three months old were divided into two lots of two each, November 2d, for experimental feeding to compare nitrogenous and carbonaceous rations.

In this experiment the animals of lot I were pigs of a sow fed a carbonaceous diet until the birth of the pigs; and the animals of lot II were pigs of a sow fed a nitrogenous ration. These sows were of the same breeding and received the same rations respectively as lots I and II of the previous experiment.

Some experiments of this nature have shown that a ration of clear corn meal and water did not give the desired results as a carbonaceous ration, because the animal would refuse to eat a sufficient quantity of the clear meal to give the desired gain. To avoid this difficulty a little animal nitrogen in the form of meat scrap was added to the ration of lot I or the carbonaceous lot.

This animal nitrogen was offset by adding scrap beef tallow to the ration.

The ration of lot I consisted of corn meal, 27 parts; beef tallow, 2 parts and meat scrap 1 part.

The ration of lot II consisted of corn meal, 2 parts; meat scrap, 1 part; and skim milk. The amount of skim milk fed to lot II varied somewhat from day to day, as the supply varied, so considerable water was drank by this lot during the experiment. Fresh water was constantly kept in water boxes accessible to each lot during the entire experiment.

Tables XV and XVI give the amount of food consumed by each lot, with the pounds of digestible constituents and the nutritive ratio for each lot.

TABLE XV.—LOT I—CARBONACEOUS.

	Pounds con- sumed.	Digestible.			
		Protein, Pounds.	Fat, Pounds.	Nitrogen-free extract. Pounds.	Fiber, Pounds.
Corn meal.....	870	67.29	26.51	535.99	6.30
Meat scrap.....	32	16.49	4.39		
Scrap tallow.....	64	.96	57.60		
Total.....	966	84.74	88.50	535.99	6.30

Nutritive ratio 1 to 9.

TABLE XVI.—LOT II—NITROGENOUS.

	Pounds con- sumed.	Digestible.			
		Protein, Pounds.	Fat, Pounds.	Nitrogen-free extract. Pounds.	Fiber, Pounds.
Corn meal.....	614	47.49	18.71	378.27	4.45
Meat scrap.....	307	158.19	42.09		
Skim milk.....	1758	75.59	3.52	73.84	
Total.....	2679	281.27	64.32	452.11	4.45

Nutritive ratio 1 to 2.2.

Table XVII gives the weights of the individuals of each lot at different periods during the experiment.

TABLE XVII.

Ear mark No.	Lot 1 Carbonaceous.		Lot 2 Nitrogenous.	
	3	4	1	2
	Pounds.	Pounds.	Pounds.	Pounds.
Wt. Nov. 2.	29.5	30.5	43.5	35
" Nov. 16.	45	38	55	43
" Dec. 21.	62	52	104	65
" Jan. 25.	87	79	139	110.5
" Feb. 12.	106.5	94.5	163.5	130
" Apr. 12.	137.5	160	219	198
Gain	167	129.5	175.5	168
Gain per day	1.18	1.07	1.45	1.85
Gain per day per lot..	2.20		2.80	

Table XVIII gives the live weight at the time of killing ; the dressed weight, and the weight of internal organs.

TABLE XVIII.

Ear mark No.	Lot 1 Carbonaceous.				Lot 2 Nitrogenous.			
	3	4	1	2	3	4	1	2
	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.
Wt. alive	167		160	8	219		198	
" after bleeding..	165		157		215		192	8
" of blood.	2		3	8	4		5	8
" of heart.		5		5.5		10		9
" of lungs	1	6	1	9	2	1	1	7
" of liver.	2	2	2	1	3		2	13
" of spleen		2.5		2		4		4
" of stomach and intestines								
Dressed weight	9	5	10		13	7	11	12
	144		137		186	8	168	

The weight of the hogs dressed was taken the next morning after killing.

It will be observed from table XVII that the nitrogenous lot made a much greater growth than did the carbonaceous fed lot. The general appearance of the hogs differed even more than their difference in weight as may be seen from figure 2, which is reproduced from a photograph taken of the hogs after dressing while they were yet on the shambles. It will be noticed that the pigs of the nitrogenous fed lot were larger, longer, and showed a

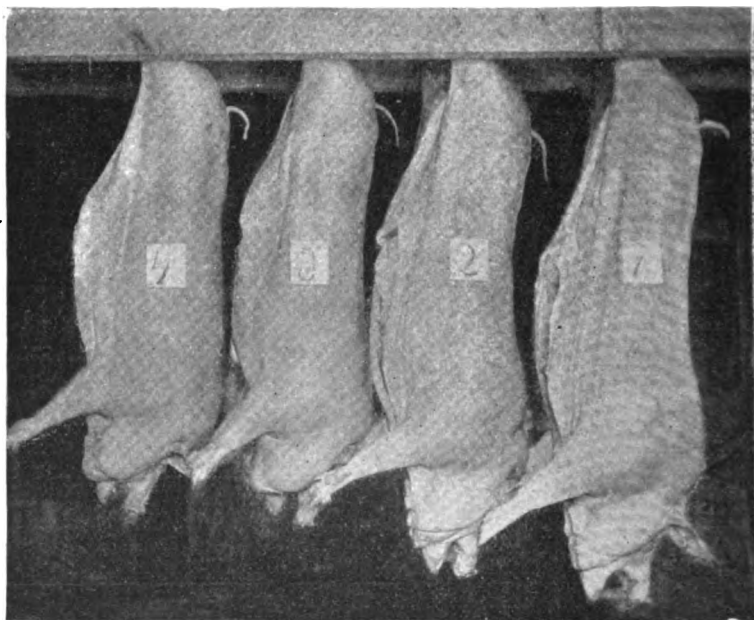


FIG. 2.—Nos. 1 and 2 Nitrogenous ; Nos. 3 and 4 Carbonaceous.

less tendency to lay on fat as seen in jowls of Nos. 3 and 4. There was also a considerable difference in the proportion of lean and fat meat of the two lots as may be seen by the illustration on the title page.

The illustration marked 3 on the title page represents a cross section of pig number 3 of Lot I taken through the loin, and when compared with the illustration marked 1 taken from a similar section of pig 1 of Lot II, the relative proportion of lean and fat meat is seen to be marked. In the animal fed on carbonaceous food the amount of fat meat is not only greater but

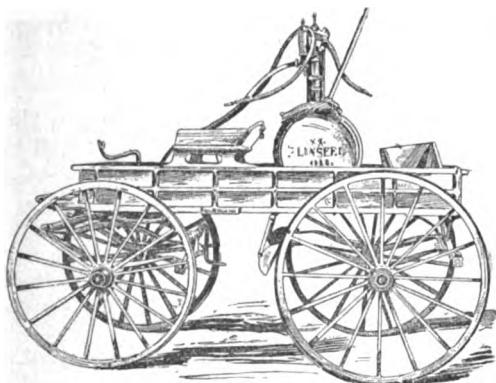
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Cornell University Agricultural Experiment Station.

HORTICULTURAL DIVISION.

SPRAYING APPLE ORCHARDS IN A WET SEASON.



By E. G. LODEMAN.

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38. The Cultivated Native Plums and Cherries.
39. Creaming and Aerating Milk.
40. Removing Tassels from Corn.
41. On the Comparative Merits of Steam and Hot Water for Greenhouse Heating.
42. Second Report upon Electro-Horticulture.
43. Some Troubles of Winter Tomatoes.
44. The Pear-Tree Psylla.
45. Tomatoes.
46. Mulberries.
47. Feeding Lambs and Pigs.
48. Spraying Apple Orchards in a Wet Season.
49. Sundry Investigations of the Year.

CHEMICAL DIVISION.

THE DETERMINATION OF SUGAR IN THE TOMATO.

This determination requires some special precautions ; the possible action of the organic acids present on polarized light, precludes the use of the polariscope, and the possible action of other reducing substances than sugar on the Fehling solution is liable to render the results by this method too high.

These possibilities may perhaps account for the different results obtained by different analysts on the sugar in this fruit, although it is true that there may be wide variations in the actual proportion of sugar in different varieties.

In the Report of the Maryland Experiment Station for 1889, p. 67, are the results of the determinations of sugar in 65 varieties, the percentage ranging from 1.76 to 3.52 ; one variety gave 7.00 per cent. The determinations were made in the aqueous extract directly, with Fehling's solution, used according to the volumetric method. In the Report of this Station for 1891, from 3.89 to 5.12 per cent. of sugar is reported, as obtained by H. Snyder on eight samples ; in these determinations the extract was examined by the polariscope. Two analyses by Italian chemists gave, respectively, 1.74 and 3.7 per cent.

In the case of nearly half of the analyses made at the Maryland Experiment Station the sum of the percentages of ash, sugar and malic acid exceeds the total per cent. of dry substance ; it is thus indicated that some of these determinations of the constituents of the dry substance are too high ; and as other substances besides these three are in all probability present in this dry substance, the error is even greater than thus indicated.

Some study has been devoted to the method of determining sugar in this fruit, and the matter is still under investigation. The following is given as a preliminary report only.

It was hoped that the fermentation method could be applied ; but as results even on samples of pure glucose were unsatisfactory, its use was given up. For all the determinations reported below, the fruit was dried at 100°, the dry residue was powdered, and then extracted for the sugar by boiling water when this was the extracting agent used, or by 90 per cent. alcohol in the apparatus used in this laboratory for continuous extraction of fat by ether. The aqueous extract was so dark colored that a volumetric determination by the Fehling solution could not be made ; the alcoholic extract was much less highly colored. This solvent was used in the hope that it might extract less of other reducing substances than sugar, than water would take up. The gravimetric method, in which the copper reduced from the cuprous oxide by hydrogen was weighed, gave very satisfactory results.

The results obtained are given in the following table :

No. of sample.	Dry substance.	Sugar. Volumetric det.	Sugar. Gravimetric det.	Acid.
1	5.58	.33		.33
2	6.56	.57		.44
3	5.71	.43		.44
4	6.49	.56		.35
5	6.04	.38		.72
6	4.97		.69	1.73
7	3.89		.96	.58
8	5.72		.93	.57
9	5.70		1.01	.36
10	5.26		1.13	.34
11	6.17		1.09	.60
12	6.10		.89	.45
13	5.52		1.07	.54

The acidity was determined by means of a standard solution of potassium hydroxide, and calculated as malic acid.

It seems certain that the volumetric results were too low. The gravimetric results were obtained with the alcoholic extract ; duplicate results on the same extract agreed closely. It will be noticed that one very low result on sugar in sample 6, was accompanied by a very high per cent. of acid.

G. C. CALDWELL.

BOTANICAL DIVISION.

GOLDEN ROD WEEDS.

Complaints having been made in certain quarters in regard to the tendency of some of the Golden Rods to become more or less troublesome weeds, this note upon the subject has been prepared.

The Golden Rods constitute the genus *Solidago* of the botanist, one of the largest and most important genera of the sunflower family. They are all late summer or autumnal blooming plants, bearing clusters of small flowers, usually of a yellow or golden color. The roots are perennial, but the stems, for the most part slender or wand-like in form, are annual and herbaceous, or somewhat woody in mature plants.

About eighty species of Golden Rod are known. These vary in height from six inches or less in the Alpine variety of *Solidago virgaurea*, to eight feet or more in the large variety of *Solidago serotina*. They also differ more or less in the habit and general appearance of the plants, in the form and size of the flower clusters, in the size and texture of the leaves, and in other ways.

Nearly all the Golden Rods are attractive plants, chiefly on account of the rich, warm, golden color of the flowers. The high esteem in which they are generally held has led to a wide-spread proposal that the Golden Rod should be adopted as a national flower. Whether some particular species should be chosen, or whether any one of the eighty species might be regarded as answering all the requirements of the case, is a phase of the subject which has thus far received but little consideration.

The Golden Rods are nearly all natives of Eastern North America. Only a single species, *Solidago virgaurea*, is native to Britain and continental Europe. The number of species known to be native to the State of New York was placed at twenty-two by Dr. Torrey in 1843. Prof. Dudley admits in the Cayuga

Flora sixteen species as growing wild in the basin of Cayuga Lake. These are all found in the vicinity of Cornell University. Within one hundred miles of the city of New York twenty-five species have been recorded by the Torrey Botanical Club. In the state of New Jersey there are twenty-four species, and in the state of California only seven. In the whole of North America north of Mexico, Dr. Gray includes seventy-eight species. These figures give a general notion of the natural distribution of the Golden Rods and the relative frequency of their occurrence in different sections.

But little attention has been given to the cultivation of the Golden Rods in this country, largely owing no doubt to their abundance as wild plants. In the old world, on the other hand, where as stated only a single species is known, a considerable number are cultivated for ornamental purposes. In Nicholson's Dictionary of Gardening fifteen species are named as cultivated plants in England; but it is stated that as "they are of a coarse habit they are mostly confined to shrubberies and borders." In the botanical garden of the University all the Golden Rods native in the Cayuga Flora are cultivated by the Botanical Department for scientific purposes; and it is of interest to note that nearly all show a marked tendency to respond to the influence of cultivation in the direction of amelioration and improvement.

There is no tendency of the Golden Rods as a whole to become weeds, but a few species are regarded as intrusive and troublesome in some sections. In Halsted's check list of American Weeds ten species are included; in Darlington's American Weeds only a single species is specially named. In the state of New York, especially in the central counties and in the dairy regions, about four species have attracted attention on account of their habits as weeds. These may be named and described as follows:

1. *Solidago nemoralis*. Usually about a foot in height, the foliage of a grayish-green color. The flowers begin to appear in August—the earliest of the Golden Rods. This perhaps more than any other species has assumed a pronounced weed-like character, in certain soils and exposures over a wide extent of territory. As a weed it is common in upland pastures, especially in cold and sterile soils. In such situations it drives out grasses

and other desirable forage plants almost completely. It may be banished by subjecting the soil to hoed crops for a year or more, and by the proper use of fertilizers. In very poor soils, where this Golden Rod has secured a firm foot-hold, it is probable that the cost of eradication would exceed the value of the land for farming purposes. The intrusion of this weed into fields not already invaded should be carefully guarded against.

2. *Solidago rugosa*. Usually a larger plant than the last, but quite variable as to size. The stem is very leafy, and both stem and leaves are rough with short and stiff hairs. Like No. 1 it is capable of invading fields and pastures and driving out all desirable forms of vegetation. It is, perhaps, less likely to be found on very poor soil.

3. *Solidago canadensis*. One of the largest of the Golden Rods, the rough hairy stems often six feet in height. Old plants, after the flowers have faded, are very weed-like in aspect, but in its prime is a stately and beautiful species. Common on the borders of field and pastures, which it sometimes invades more or less abundantly. Less likely than either of the first two to overrun the soil completely, but is very persistent when once established.

4. *Solidago lanceolata*. Smaller than No. 3, the stems being usually two to three feet in height. Common especially along the banks of streams, and in moist soils, and is more or less troublesome along the borders of meadows. It also invades cultivated fields and is more likely than any other Golden Rod to become a troublesome weed in such situations, largely owing to the fact that its power of propagation by underground stems is greater than in other species.

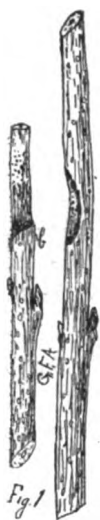
So far as is known, the different species above mentioned have nowhere received distinguishing popular names, but all are included under the general name of Golden Rod.

A. N. PRENTISS.

CRYPTOGAMIC BOTANY AND PLANT PATHOLOGY.

A NEW ANTHRACNOSE OF THE PRIVET.

A few twigs of the privet (*Ligustrum vulgare*) received from Penn Yan having the appearance of blight were communicated to me by Prof. Bailey. From 12 to 18 inches or more of the terminal



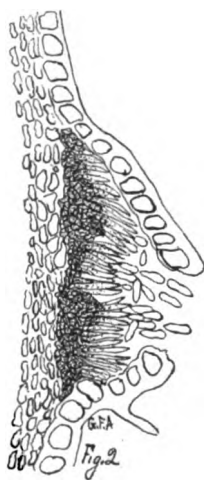
portion of some of the twigs was dead, the point where the dead portion joined the healthy presenting the depressed line observable on twigs of pear and apple affected with the blight. The resemblance to blight, however, was only superficial and confined to twigs in the final stage of the disease. Other twigs presenting an apparently healthy terminal portion were found to be diseased at a point about 12 to 18 inches from the end where a depressed area of diseased tissue was observed, oblong in outline, the longer diameter being parallel with the longitudinal axis of the stem.

A comparison of the different specimens showed that this diseased area, quite small primarily, and seated only upon one side of the twig, gradually increased in size until eventually it extended entirely around the twig completely girdling it. The supply of nutriment thus being cut off from the terminal portion of the twig, death of that portion followed.

Seated in the original diseased areas, whether extending partly or entirely around the stem, are minute black elevated points which can be seen with the unaided eye. Figure 1 *a* and *b* represent portions of twigs, *a* with the diseased area extending partly around the stem, while *b* is girdled. In the diseased areas are shown these small black elevations. The disease is produced by

a fungus which grows within the stem. These black elevated points are centres where pustules of the fungus are developed containing its reproductive bodies, or spores.

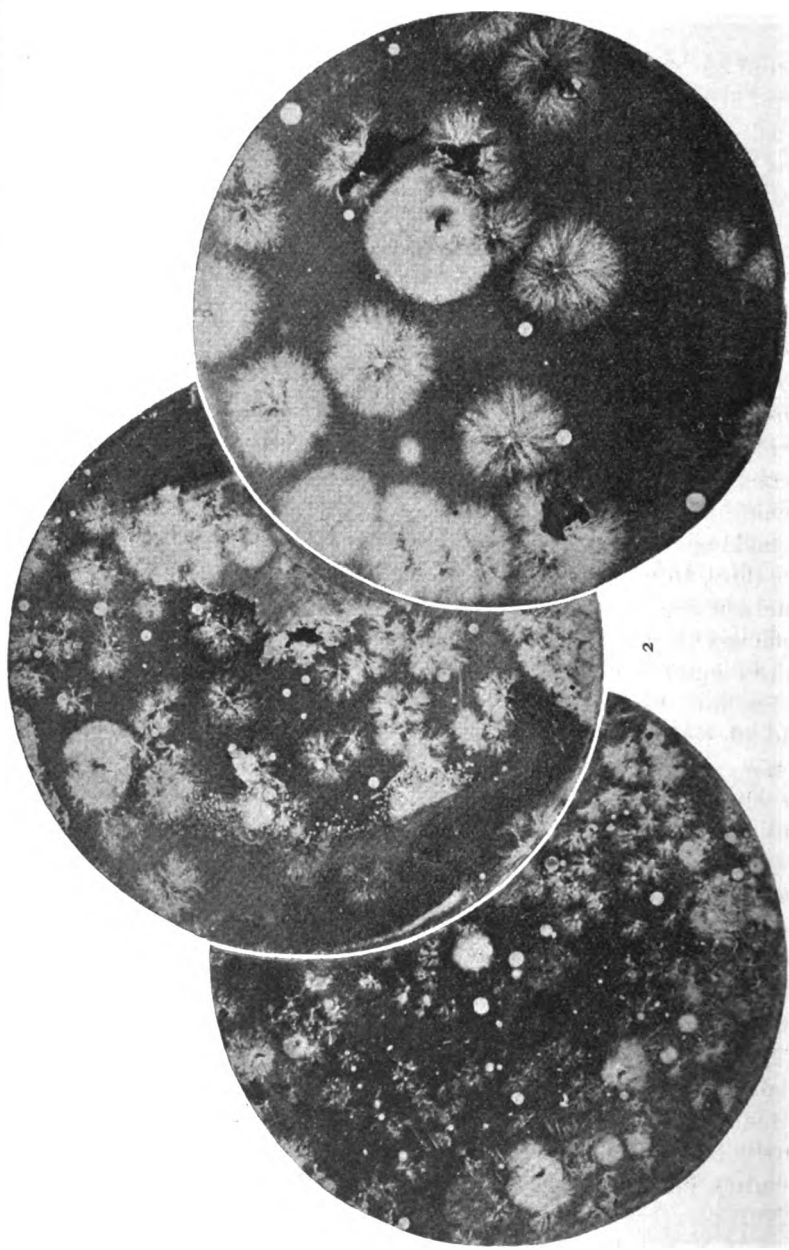
Figure 2 represents a very thin section, across one of these pustules, magnified to show the structure of the pustule and the form of the pores. The growth of the pustule has ruptured the epidermis of the stem. In the opening between the broken parts of the epidermis are shown some of the spores. Beneath these are numerous parallel short fruiting threads, or basidia of the fungus, at the end of which the spores are developed. The basidia can be seen to arise from the blackened stroma of the fungus which consists of quite a compact association of irregular cells. The black color of the pustules comes from the stroma.



Following the analogy of other anthracnoses these spores falling upon other stems would spread the disease. The practical question is, of course, how to prevent the spread of the fungus, or the starting of the disease another year. The suggestion might be made to trim the hedge with the shears below the affected parts of twigs, and burn the trimmings. It might also be well in the spring just before the buds swell to thoroughly spray the hedge with the Bordeaux mixture to kill any spores which may have remained during the winter.

Method of separation of the fungus. To study the development of the fungus it was necessary to separate it from other common forms of fungi as well as bacteria which always find a lodgment in and upon dead plant tissue. Since all these forms are microscopic the separation involves a method of procedure familiar only to specialists, and as such beautiful results were reached in the separation of this fungus it suggested a graphic presentation of the method in connection with the study. The method used was the same as that which Koch developed so admirably for the separation of bacteria, and consists in the dilution of the organisms in several quantities of a warm liquid substance which, when

CRUCI SMITHI LINDVALL



spread out in a thin layer and cooled, solidifies and holds each germ firmly fixed at one point in the dilution. This substance is usually some gelatinous base, as gelatine, or agar-agar, containing beef broth and peptone to furnish food for the organisms. In a few days after cooling the dilutions in the thin layer each germ by growth has produced a colony which can be seen with the unaided eye.

Three glass tubes containing a small quantity of liquid nutrient agar-agar were placed in a water bath at 43° centigrade. This temperature is sufficient to keep the agar liquid, while it is not hot enough to kill the organisms. Now several thin shavings through the fungus pustules on the stem of the privet were transferred to tube No. 1. This was shaken gently to distribute the germs evenly through the liquid. Now a small quantity of the liquid in No. 1 containing the germs was transferred to tube No. 2, making the second dilution, and from No. 2 to No. 3, making the third dilution. Experience enables one to judge quite accurately in making the dilutions so that we estimate the dilution sufficient to cause each germ to lie separately at different points in the liquid agar, at least in dilution No. 3.

Each of these dilutions was then poured into a Petrie dish,* and allowed to cool in a thin layer over the bottom. No germs could then be seen in the agar, since they are microscopic and lie singly. The dishes were piled away for a few days. During this time each germ grew and produced a colony which was visible to the unaided eye. The plates or dish cultures were now photographed natural size and the result is reproduced in Plate 1. In No. 3 it will be seen that nearly all of the colonies are separate. The snowflake-like colonies are those of the desired fungus. The small, compact, circular ones are those of bacteria. One large compact colony is that of a common fungus.

In Nos. 2 and 1 the fungus colonies are crowded, and have not made such good growth. The colonies of bacteria are more numerous also, and it would be very difficult to obtain a pure culture of the fungus in either of those dilutions. If the dilutions were not numbered it would be an easy thing to determine their

*A Petrie dish is composed of two shallow glass vessels, one about three inches in diameter which serves as the bottom, the other of a little greater diameter, which is inverted over the first one for a cover.

number from the size and number of the colonies. The very large compact colony in No. 2 is that of a motile bacterium.

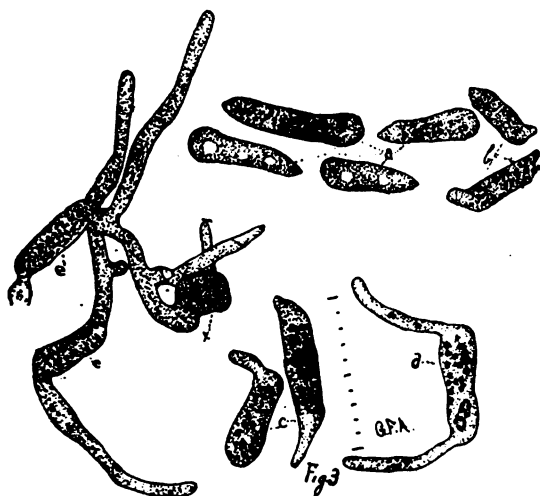
Pure cultures of the anthracnose. Pure cultures of the fungus could now be started by transplanting with a flamed platinum needle portions of the fungus colonies from No. 3 into a culture tube of nutrient agar. The photograph was taken after these transplantings were made which accounts for the broken appearance of some of the colonies.

From the point of inoculation in the culture tube, where the transplanting was made, the fungus threads grow out through the upper surface of the agar radiating in all directions. In a few days minute black bodies appear seated here and there upon the mycelium. These resemble the stroma at the base of the pustules on the stem, but in the artificial cultures do not seem to be especially concerned in the production of basidia and spores, since but a few are developed in connection with them.

Numerous basidia and spores are produced, however, all along the threads and a mass of them at the point of inoculation. In a few days more many fungus threads arise above the agar and produce a fluffy white growth upon the surface, nearly obscuring the black points.

No pigment was noticeable in these cultures. New cultures were then started by transplanting portions of agar the size of a small pea with a mat of mycelium and spores to fresh culture tubes. In the fresh agar the growth took place in the same manner as in the first tubes, but upon the surface of the transplanted portions a faint pink pigment appeared, similar to that developed in some species of *Glæosporium* and *Colletorichum*.

Cell cultures were made in order to observe with the microscope the different phases in germination of the spores and growth of the fungus. Liquid agar containing a dilution of spores from one of the culture tubes was poured upon a sterilized cover glass which was then inverted on the ring of the cell. Figure 3, *a*, represents some of the spores in the cell culture. They are oblong, usually pointed at one end, nearly cylindrical, and either straight or slightly curved. The appearance of the contents of the spores varies. Sometimes the protoplasm is nearly homogeneous with one or more vacuoles, or it may be finely granular, with



no vacuoles, or quite coarse granules may be irregularly distributed in the homogeneous protoplasm. The latter condition is a very common one before germination, and the behavior of these granules has suggested that possibly they may be stored products to be used during the process of germination.

and the early growth of the mycelium. It does not seem there could be any need of such stored products for spores in artificial cultures where the spore lies in a rich nutrient media. But they might serve the spores a good purpose in natural conditions where the spore lies upon the surface of the plant and must often produce considerable growth of mycelium before the thread reaches nutritive tissues.

In germination one or more germ tubes arise from the spore usually at one side of the ends. Figure 3, *b* and *c* represents different stages in germination. The coarse granules are quite numerous, and in *d* some of them have moved out into the forming mycelium. Figure 3, *e* represents a farther development of mycelium and also a farther distribution of the granules in the threads.

Figure 4, *a*, *b*, and *c* are three camera lucida sketches of the growth from a spore which was sown December 14th at 12:35 P. M. *a* represents the growth which had taken place in exactly 24 hours, being sketched at 12:35 P. M., Dec. 15th. *b* was sketched from the same object at 3:15 P. M. on the same day, and *c* at 11:45 A. M., Dec. 16th. The spores are therefore developed with great rapidity under favorable circumstances. In the same culture were other spores which developed a much greater extent

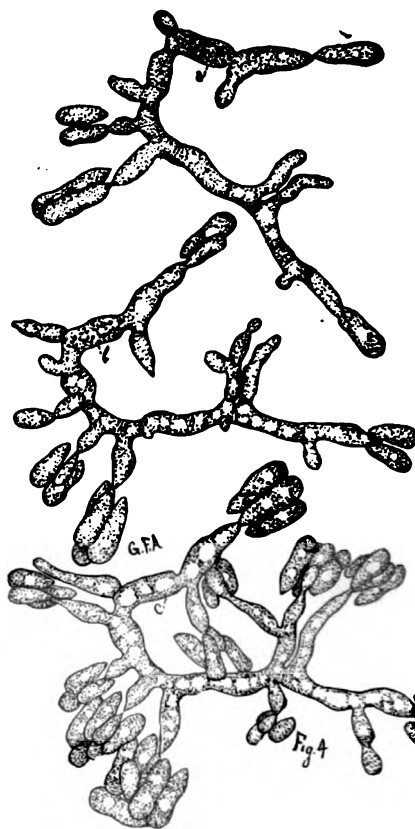
of mycelium and number of spores. This group was chosen because of its limited extent, being thus more convenient to sketch.

During the growth and production of spores the coarse granules gradually disappear. As the culture ages the mass of spores becomes greater at the center of each group of mycelium. In a few days spore production seems to cease and then long, sterile mycelial threads grow out to a considerable distance.

At the same time there are usually developed buds or gemmæ, at the ends of certain threads. These are colorless at first and may be detected by their irregularly oval outline, and greater diameter than the parent thread. They soon acquire a dark brown color, sometimes become septate, or bud into rudimentary sclerotia.

One of these developed quite early in the culture is shown at x, figure 3.

Spores were also sown on sterilized bean stems. The fungus grew readily and produced numerous spores during a few days when the threads assumed a dark brown color and grew in great profusion over the surface of the stems. Frequently the threads associated themselves into strands, or compact wefts of parallel threads several layers deep. Within these wefts and strands were developed numerous bodies suggesting pycnidia or perithecia, rotund in form, the interior cells hyaline and with rich protoplasmic contents, the peripheral cells dark brown in color.



In some cases these measured 80 to 100*, and frequently the depth of the weft of dark mycelium in which they were seated exceeded this measurement.

Late upon the surface of this growth free threads arose in a procumbent, assurgent, or nearly erect position. All of this development on the bean stems took place in ten days. This culture is very suggestive of the probable development cycle of this *Glæosporium* and related forms. It probably presages the development of an ascigerous stage; whether or not that ever actually takes place is yet to be determined. The blackening of the stroma in the pustule on the stems of the privet is probably analagous to the dark weft of mycelium developed over the bean stems in the culture. In this respect the fungus resembles the *Glæosporium* of ripe rot of apples.†

In the report of the Mycologist, Dept. Agr., 1887, p. 348, there is noted what seemed to be an immature pycnidial stage of *Glæosporium fructigenum*. On apples, affected with *Glæosporium fructigenum*, which were kept until mid-winter, Miss Southworth notes one conceptacle in connection with the stroma containing two asci and undeveloped spores, but the culture was so badly contaminated with other forms that it was thrown away.‡ The culture being contaminated there might be some doubt of its genetic connection with the *Glæosporium*, but all this strengthens the possibility that several anthracnoses in the future will be known as conidial stages of some more highly organized form.

The result of these cultures is to impress one with the close relationship of this *Glæosporium* on the privet to the *Glæosporium fructigenum* on apples. If it were the same species the cultivation of the privet would then bear a new and important relation, perhaps, to the spread and propagation of the ripe rot of apples. There are points of difference, however, so far as the two species are at present known, sufficient to characterize it as a hitherto undescribed species, and I propose for it the name *Glæosporium cingulatum*, or the *girdling anthracnose*.

* These measurements are in terms of the micromillimeter.

†Miss Southworth. Ripe rot of grapes and apples. *Journal Mycology*, Vol. vi, No. 4.

‡ *Journ. Mycology*, Vol. vi, No. 4.

Glæosporium cingulatum ns. p. Affected areas light brown, either oblong and on one side of the stem or later completely girdling it. Acervuli 100 to 150 in diameter, rupturing the epidermis, in age black from the dark stroma lying in the base or extending irregularly up the sides frequently forming a pseudopycnidium. Basidia numerous, crowded, simple, hyaline or when very old perhaps faintly fuliginous. Spores oblong, or elliptical straight or little curved, usually pointed at the base. From pustules on the stem they measure 10—20x5—7; in artificial cultures they are frequently much larger, but when crowded in the media, or when the nutrient substances are nearly exhausted, they may be considerably smaller—on stems of *Ligustrum vulgare*.

This is quite distinct from *Glæosporium ligustrinum* Sacc.*

NOTE ON THE CERCOSPORA OF CELERY BLIGHT.

Late in September, specimens of celery affected by "celery blight," sent by H. C. Townsend of Wappinger's Falls, Dutchess Co., were communicated to me by Mr. Turner of the New York Weather Service. The disease was determined as due to the fungus *Cercospora Apii* Fres. A short note on the disease was then published in the Crop Bulletin of the New York Weather Service, for the week ending Sept. 24, 1892. It has long been known in Europe and has been recorded several times in various parts of the United States during the past several years. It sometimes occasions quite serious injury to the celery crop, in some cases materially lessening the product and also rendering the diseased plants less desirable for market.

Halsted of the New Jersey Experiment Station shows that the disease can be held in check by the use of the standard carbonate of copper and ammonia mixture applied with a knapsack sprayer.‡

The object of this note is chiefly to call attention to some confusion which exists concerning certain morphological characters

*Sylloge Fungorum, Vol. iii, p. 704.

‡Twelfth Annual Report N. J. Agr. Expt. Station, 1891.

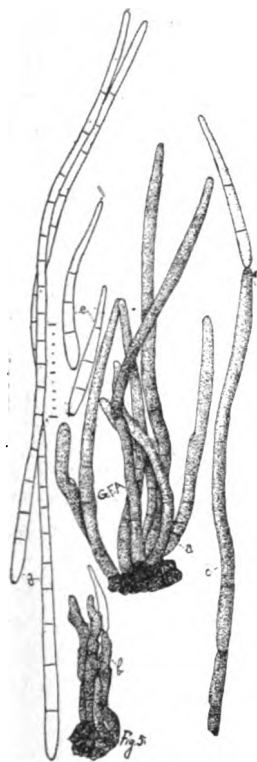
of the fungus. Like all *Cercospora* the vegetive threads of the fungus usually grow largely in the interior of the leaf and when the nutriment at the affected spot is nearly exhausted, clusters of fruiting threads arise from the vegetive ones, and issuing from a stoma of the leaf bear elongated spores at their ends. Two clusters of the fruiting threads of *Cercospora Apii* are shown at *a* and *b* in figure 5, while *c* represents a single fruiting thread with a spore still attached, and free spores are shown at *d* and *e*.

The fungus was first described by Fresenius.* The description given by Saccardo† represents the form developed under normal conditions, the hyphæ measuring 40-60x4-5 and the spores, or conidia, 50-80x4. The form of the conidia is given as obclavate, *i. e.*, the base or end at the point of attachment with the hyphæ is greater in diameter than the distal extremity. The conidium *in situ* at the end of the hypha, figure 5, *c*, shows this character well. It was also observed in numerous other cases. Furthermore the free or abjoined conidia nearly always present a well defined scar at the larger end as shown in *d* and *e* figure 5. This scar indicates the place of attachment to the hypha, the corresponding scar on the hypha being at the end or at one of the geniculations as shown in *a* and *b* figure 5. The explanation of several scars appearing on a single

hypha is that after a conidium is abjoined from the end, the hypha then grows out at one side of the scar and bears another conidium at the end, and so on. These scars at the base of the conidia enable one to determine their form even when they are not attached to their parent hyphæ.

*Beiträge zur Mykologie, Frankfurt, 1850-1860.

†Sylloge Fungorum, Vol. IV, p. 442.



In the report of the Mycological Section* for 1886 is a short note on the distribution of this fungus in the United States. The form of the conidia is not given in the text, but they seem to be inverted in the illustration where they are shown to be attached by their small ends to the hyphæ. Figuring them thus is equivalent to calling them clavate with reference to their relation to the hyphæ which is contrary to the original descriptions and also to fact.

In the report of the New Jersey Station for 1891 (l. c.) the conidia are described as club-shaped. No figure is given and we infer that the writer used the term "club-shaped" without any reference to their relation to the hyphæ.

Under normal conditions the fungus is confined to well defined spots on the leaf with an irregular, slightly raised border. During excessively wet weather, as the leaf tissue is dying, it may spread to portions of the leaf where the spots are not so well defined. Such conditions also induce a much longer growth of the tufts of hyphæ and their conidia. Figure 5 *a* and *d* represent such forms in comparison with *b* and *c* developed under normal conditions. The measurements including such variations are as follows: Hyphæ 50-150x4-5; conidia 50-280x4-5. The figures are all drawn to the same scale, using compensation ocular No. 6 and objective 4mm, Zeiss, with aid of camera lucida. The micrometer scale of this combination is also projected by the side of the figure.

GEO. F. ATKINSON.

*Report, Department of Agriculture.

‡ All the figures where the scale is shown are drawn with the same combination, the objects being magnified 30 times more than the scale.

AGRICULTURAL DIVISION.

CORN—DETASSELING EXPERIMENT.

July 20th, 1892, a portion of the University corn field was selected for an experiment in testing the effect on corn production, of removing the tassels as soon as they appeared. This portion consisted of 44 rows of corn with 27 hills in each row. This plot was surrounded on all sides by corn of the general corn field, was of the same variety of corn, Pride of the North, and received the same cultivation as the rest of the field.

The tassels were removed on alternate rows for the first 20 rows and on three-fourths of the rows of the remaining 24 rows. That is, the tassels were removed from three rows and left on the fourth; removed from the next three and left on the fourth, and so on throughout the 24 rows. The tassels were removed as soon as they could be seen, and before they had expanded. The operation was performed by hand by giving the tassel an upward pull which caused the stalk to break off above the upper joint without injuring the leaves at all.

From the three experiments made at this station in detasseling corn it has been observed that it is of the *utmost importance to have the tassels removed at the earliest time possible*, certainly before they have become expanded, and still better if enclosed within the folds of the leaf. These tassels may be readily removed by pulling as described above when enclosed in the leaf, if only the very tip of the tassel be exposed to view. And further, it is essential that the tassels be removed in such a manner that the leaves are not in any way injured, which would be the case were they removed *at the proper time* by a corn knife.

The following tables give the number of stalks, the abortive, good and poor ears, the weight of stalks, and the weight of good and poor ears for each row.

TABLE I.

		Number of ears.			Weight of ears.		Weight of stalks.
	Num- ber of stalks.	Abor- tive.	Good.	Poor.	Good.	Poor.	
Row 1, Tassels removed...	128	40	70	53	32.5	11.	70.
" 2, " left on.....	128	44	60	48	30.	9.	80.
" 3, " removed...	133	47	69	54	33.5	12.5	76.5
" 4, " left on.....	122	30	52	49	27.	8.5	76.5
" 5, " removed..	129	47	62	56	32.	13.	75.
" 6, " left on...	121	38	62	40	30.5	10.	77.5
" 7, " removed..	129	47	70	50	35.	11.5	76.
" 8, " left on....	130	29	55	47	28.5	11.	76.
" 9, " removed..	117	30	60	50	30.5	13.5	66.
" 10, " left on....	130	29	55	53	28.5	12.	82.
" 11, " removed..	120	51	73	39	37.	11.5	75.5
" 12, " left on....	116	35	52	40	27.	9.	74.5
" 13, " removed..	122	39	57	34	36.	8.	70.5
" 14, " left on....	120	29	63	44	32.5	11.	77.
" 15, " removed..	133	36	72	44	36.5	12.	77.
" 16, " left on....	127	29	75	27	39.	5.	83.
" 17, " removed..	125	23	77	49	38.	12.5	76.5
" 18, " left on....	114	35	58	37	30.	7.5	79.5
" 19, " removed..	114	25	60	49	29.5	13.	70.
" 20, " left on ..	107	20	40	47	26.	10.	70.5
Average Tassels left on	122	32	57	43	30.	9.	78.
" " removed ..	125	39	67	48	34.	12.	73.

Gain in weight of good ears, 13 per cent.

Gain in weight of poor ears, 33 per cent.

It will be observed that these results show a gain in numbers of good and poor ears, also in their weight. An average increase of 15 per cent. of good ears and 26 per cent. of poor ears by weight.

In this experiment all short and poorly formed ears were counted as poor ears, although the corn was practically all sound. All sets producing silk without grain were counted as abortive ears.

As the experiment of removing tassels from corn has been made at several experiment stations with varying results, a general summary of the results to date may be of value in drawing conclusions on the effect of the practice. The results of the various experiments made at different experiment stations may be summed up as follows :

TABLE II.

	Num- ber of stalks.	Number of ears.			Weight of ears.		Weight of stalks.
		Abor- tive.	Good.	Poor.	Good.	Poor.	
Row 21, Tassels removed..	125	43	70	47	35.	14.5	77.5
" 22, " " "	105	22	64	40	32.5	11.	74.
" 23, " " "	116	30	72	41	35.5	10.	70.5
" 24, " left on....	121	36	62	42	32.	9.	79.
" 25, " removed..	110	54	72	31	38.	7.5	78.
" 26, " " "	127	22	72	40	36.5	9.5	71.5
" 27, " " "	129	35	69	46	36.	11.	72.5
" 28, " left on....	133	36	50	50	26.	11.5	78.
" 29, " removed..	126	29	63	56	31.	13.5	70.
" 30, " " "	120	44	62	53	32.5	13.	75.
" 31, " " "	111	38	61	46	32.	11.5	67.5
" 32, " left on....	129	32	60	46	30.5	9.	65.5
" 33, " removed..	118	33	52	58	27.	14.	67.5
" 34, " " "	110	35	62	41	32.	12.	66.5
" 35, " " "	109	30	66	46	34.	13.5	65.
" 36, " left on....	130	33	56	37	27.	9.	68.5
" 37, " removed..	120	36	60	56	32.	14.	71.
" 38, " " "	124	37	69	48	36.	11.	73.5
" 39, " " "	115	25	70	54	37.5	13.	74.5
" 40, " left on....	136	29	60	47	31.5	10.	80.5
" 41, " removed..	114	34	60	54	35.	16.	78.5
" 42, " " "	128	30	74	49	39.	12.	80.5
" 43, " " "	124	26	78	38	39.	9.	78.
" 44, " left on....	123	36	54	46	28.5	11.	86.5
Average Tassels left on... ..	129	34	57	45	29	10	76
Average Tassels removed...	118	34	66	46	34	12	73

Gain in weight of good ears, 18 per cent.

Gain in weight of poor ears, 20 per cent.

Nebraska—Two experiments; tassels *removed by a corn knife*; results decidedly unfavorable.

Kansas—A gain in favor of removing the tassels.

Maryland—Slightly decreased yield.

Of three experiments at this station, two give an increase in yield of 50 per cent. and 17 per cent. respectively, while the third shows no change in yield.

It will be noticed that of the total number of experiments, about one-half have received a marked increase in the yield of corn and about one-half report a decrease, but from the experi-

ments made in removing the tassels as soon as they could be seen and without injuring the leaves, the results show, as an average, a *marked* increase in the yield of grain.

The varying results of these experiments tend to show that there are some conditions not well understood, that have a marked influence on the result of this practice, and that it is worthy of more extended investigation.

GEORGE C. WATSON.

EFFECT OF FERTILIZERS ON TOBACCO.

In the spring of 1892, four plots were selected to make a test of different kinds of fertilizers on tobacco. This test was made as a preliminary trial to future experiments and intended only as a guide for investigations in testing different kinds and qualities of fertilizers when applied to the tobacco crop. As these results were quite marked, the publication of a brief account of the experiment seemed to be warranted from the data obtained.

Of the available land for this experiment four adjoining plots of $\frac{1}{4}$ acre each were selected. The soil was a heavy clay loam quite poor in plant food, and not very uniform. Although the plots were only four rods long, the soil varied considerably from one end of the plots to the other. These plots were situated on a western slope; the east or upper ends of each plot was more clayey and the west or lower ends more loamy. This variation in the soil was quite uniform throughout all the plots, that is the soil in one plot varied about as much as it did in another.

April 15th, a load of 2355 lbs. of barn manure was spread on plot one. April 18th all plots were plowed.

June 21st, plots 1, 2 and 3 were set to Zimmer Spanish tobacco, setting five rows to each plot and forty plants to the row.

June 24th, plot 4 was set to Spanish Zimmer tobacco, with plants like those set on the other plots.

A commercial fertilizer containing nitrogen, phosphoric acid and potash was applied to plots 2 and 3 on the following dates:

July 1, July 14, August 6.

The potash applied to plot 4 was in the form of a high grade sulphate (90 per cent. pure), while the potash applied to plot 3 was in the form of a chloride (muriate) 80 per cent. pure.

4.8 lbs. of potash, 3.16 lbs. nitrogen, and 3.20 lbs. of phosphoric acid was applied to each of plots 2 and 3. The nitrogen was in the form of nitrate of soda, guaranteed 96 per cent. pure. The phosphoric acid was in the form of available fine rock phosphate.

The fertilizers were sprinkled around the plants and hoed in. Plot 4 received no fertilizer whatever, but received the same cultivation as plots 1, 2 and 3. September 17th, the tobacco on all plots was cut and weighed, the weighing being done immediately after cutting.

The following plan of the plots will show the amount of fertilizer applied to each plot and the weight of tobacco at the time of cutting. This plan shows the relative location and size of the plots, with the kind and amount of fertilizer applied, and also the yield of tobacco.

EAST.

PLOT 1.	PLOT 2.	PLOT 3.	PLOT 4.
Barn manure, 2355 lbs.	Sulphate of potash, 10 lbs.	Chloride of potash, 10 lbs.	No fertilizer.
	Nitrate of soda, 20 lbs.	Nitrate of soda, 20 lbs.	
	Plain super phos- phate, 20 lbs.	Plain super phos- phate, 20 lbs.	
Weight of tobac- co, 517 lbs.	Weight of tobacco, 457 lbs.	Weight of tobacco, 442 lbs.	Weight of tobac- co, 236 lbs.

WEST.

From the foregoing plan of the plots it will be observed that the barn manure plot produced the most tobacco, but if the cost of the fertilizers of all the plots are taken into account it will be seen that the commercial fertilizer may be favorably compared to the barn manure, and that the commercial fertilizer produced about twice the weight of tobacco as did the adjoining plot which received no fertilizer.

Although the plots receiving the commercial fertilizer received the same number of pounds each of plant food, the slight difference in yield in tobacco cannot safely be attributed to the difference in the quality of the potash applied without being corroborated by other trials.

While the yield of tobacco from the plot treated with barn manure was somewhat greater than the yield from the plots treated with commercial fertilizers, it is not at all certain that more tobacco was grown for the plant food supplied on the manured plot, than on the plots treated with commercial fertilizer.

GEORGE C. WATSON.

RESIDUARY EFFECT OF A GRAIN RATION FOR COWS AT PASTURE.

During the summer of 1891, an experiment was made in feeding grain to a herd of milch cows at pasture. In selecting this herd the aim had been to secure a herd where the practice had not been to feed grain while at pasture, and where the conditions as regards the pasture and the care of the animals would fairly represent a large proportion of the farm dairies of the state. Such a herd was found at McGrawville, the property of C. M. and W. L. Bean, and placed at the disposal of the officers of this station in conducting this experiment, which lasted from May 22 to October 23.

The results of this experiment were published in detail in Bulletin 36, December, 1891, and may be briefly stated as follows :

A herd of 16 cows, thoroughbred and grade Jerseys, was divided into two lots of eight each. Lot I, received

2600 lbs of corn meal.
 1300 " cotton seed meal.
 1300 " bran.

Total 5200 lbs of grain.

Lot II received no grain.

Lot I gave 22628.5 lbs. of milk.

Lot II gave 17697.75 lbs. of milk.

Or 4930.75 lbs. of milk more for the grain fed lot, a gain of about $3\frac{1}{2}$ lbs. per cow per day. The cows of this herd were quite thin in flesh, but made a good gain in live weight during the experiment. The grain-fed lot gained 166 lbs. per cow and the lot receiving no grain gained 113 lbs. or a gain of 53 lbs. per cow in favor of the grain-fed lot. Since the grain-fed lot had given about 27 per cent. more milk and had gained 53 lbs. in live weight per cow more than the lot receiving no grain, the question then arose whether this increased milk flow and the gain in live weight of lot I over lot II would have any influence on the flow of milk the following year. Accordingly the weight of milk produced by each cow that still remained in the herd was recorded for six months, beginning April 1, 1892.

The following table shows the weight of milk per cow, per month, for each lot, and the difference in favor of the grain-fed lot of the cows still remaining, or six cows in each lot :

	Lot 1.	Lot 2.	Difference.
April	473.8	354.8	119.
May	619.7	540.2	79.5
June	750.8	646.3	104.5
July	683.5	570.1	113.4
August	535.7	499.9	35.8
Sept.	376.4	348.4	28.
			480.2

A gain of 16.2 per cent. in yield of milk.

From this table it may be seen that for six months, beginning with April of the season following that which the grain was fed, the lot which received the grain gave 480.2 lbs. of milk per cow more than did the lot receiving no grain. This gain represents an increase of a trifle more than 16 per cent. in favor of the grain

fed lot. It seems reasonable to assume that this increased production was due to the grain fed the preceding year, especially in the case of the younger animals. Indeed it was plainly evident that the grain fed two year olds and three year olds developed into better animals than their stable mates having no grain.

I. P. ROBERTS.

ENTOMOLOGICAL DIVISION.

THE BLACK PEACH APHIS.

Aphis persicæ-niger.

Order *Hemiptera* ; family *Aphididæ*.

A small brownish-black plant-louse often appearing in great numbers upon the leaves, twigs, and roots of young peach trees, frequently dwarfing and often causing the death of the tree.

The object of this article is to call the attention of peach growers to the fact that a very serious insect pest is being introduced into our state upon nursery stock purchased in other states. A correspondent in Niagara County has introduced the pest into his orchard of twenty acres by filling in the places where trees had died with infested trees received last spring from a nursery in Delaware. A few infested trees which were left over were trenched near some pits just planted ; the pest soon found its way to the young seedlings, and by midsummer nearly every seedling had succumbed to the attacks of the aphids. So far as we know this is the first instance of the occurrence of this insect in our state, but probably other growers have suffered previously more or less in other localities without knowing the cause.

The insect is very common throughout the whole of the great peach growing districts of New Jersey, Delaware, Maryland and Virginia. Growers there say it is more to be dreaded than the borer (*Sannina exitiosa*), and in destructiveness it ranks next to the fearful mysterious disease of Peach Yellows. Trees less than three years old suffer the most. In 1890, nearly 100,000 in a single nursery in one of these states were killed in two or three weeks' time, while many other large nurseries were either entirely destroyed or very badly affected, and many orchardists were compelled to replant hundreds of trees. Nurserymen, and those who are starting peach orchards, can thus see what fearful havoc may result if this pest is once introduced among their trees.

Indications of the presence of the pest.—As the pest often confines its attacks almost entirely to the roots of the trees, its deadly work frequently appears when there is nothing to indicate the existence of an insect as its cause. A stunting or dwarfing of the young trees is one of the most marked symptoms of the presence of the pest. Sometimes three or four year old trees are but little larger than when first set. The foliage of such trees presents a yellowish-green sickly appearance. Rarely a tree after languishing a year or two recovers and makes a good tree. Under favorable conditions the insect may appear in great numbers on the tree above ground and its growth be nipped while yet in the bud; the growing shoots dry up and the young tree soon dies.

Its past History.—This insect has been known to the peach growers of the Atlantic States for more than a quarter of a century. From 1860 to 1875 it was particularly destructive to Maryland. In 1874 it is first recorded as appearing above ground in destructive numbers. While investigating the Peach Yellows in 1887, Mr. E. F. Smith came across the insects upon the roots of the trees; and as the Yellows had by some been attributed to this aphid, Mr. Smith made many observations on the pest from which we get most of our knowledge of its life history and habits. The severe outbreak of 1890 has already been noted. Two or three years ago the pest was carried into the Michigan peach district on nursery stock from the east. It seems not to have gained a foothold among the California orchards as yet; the Board of Horticulture of that state is fully alive to the importance of the pest, and it is on the alert to prevent its introduction.

Its classification.—This insect is one of the true bugs belonging to the same family—the *Aphididae*—as the Grape Phylloxera, the Grain Aphid, the Hop Louse, and many other well known plant-lice pests. Scientifically the insect is known as *Aphis persicæ niger*—the Latinized form of the common name, Black Peach Aphid. This name was given it in 1890, by Mr. E. F. Smith, who after comparing it with descriptions of allied known species became convinced that the species was new and so described it. Mr. Smith believes that the insect is a native species, as he found it common on the roots and branches of the wild plum, *Prunus chicasa*, thus indicating that this may be its original food plant.

The appearance of the insect.—The pest appears in two forms,

the more common form without wings (Fig. 1), and a form occurring in limited numbers provided with four ample wings (Fig. 2). The adult wingless insect is a little less than one-tenth of an inch in length and of a dark shining brownish-black color with portions of the legs yellowish. Figure 1 shows the shape and general appearance of the wingless form; the hair line at the right represents the natural length of the body. Two very short tubercles

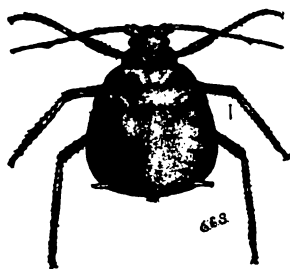


FIG. 1.—*Wingless viviparous female.*

called honey-tubes project from the caudal end of the abdomen. The beak lies along the breast of the insect when at rest but when feeding it is placed against the leaf at right angles to the body, and four fine bristles moving in a groove of the beak are forced into the tissues and the sap is pumped through this apparatus into the body.

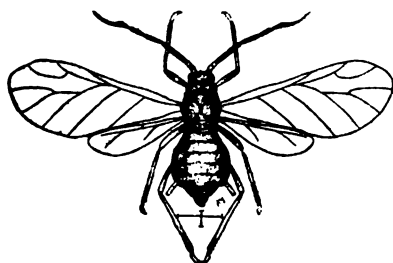


FIG. 2.—*Winged viviparous female.* (After J. B. Smith).

The adult winged forms have the long transparent wings carried roof-like over the sides of the body when at rest. These forms also differ from the wingless ones in being slightly longer and more slender, and in having longer antennæ and honey-tubes, as is shown in figure 2; the lines beneath the figure represent the natural size of this form.

In its younger stages the insect resembles the adult, but is lighter in color. All the forms thus far observed are females; often plant-lice breed freely for many generations or even years without the appearance of males, nothing but the agamic females being produced.

The life history of the insect:—Plant-lice present more varied, peculiar, and interesting phases in their life histories than do most other insects. The mother is often viviparous, that is she brings forth her young alive; the little louse may be seen kicking to free itself from the mother who is perhaps calmly walking about or

feeding. Many generations of these agamic females may be produced in succession, and it requires only eight or ten days for a generation. And further, as one mother may give birth to one hundred young at the rate of four or five a day it is easy to see with what astonishing rapidity these insects may often multiply.

The Black Peach Aphis breeds thus agamically all the year round, and no eggs nor males have been found. Only the wingless forms occur upon the roots where they breed freely and are to be found at all seasons of the year, often a foot or more beneath the surface even in stiff clay soils ; sandy soils are however preferred by the pest.

Early in spring as soon as the buds begin to swell, some of these root forms make their way to the surface and to the branches. Here the winged form develops and flying to new quarters founds other colonies, thus spreading the pest. These branch forms are the most numerous from April to July. About midsummer most of these make their way to the ground and to the roots. Usually a few specimens remain on the leaves throughout the summer and autumn and even through the winter. Our correspondent in Niagara County wrote us November 24th, that although it had frozen hard twice, the aphids were as lively as ever on the branches. These individuals which thus hibernate upon the branches with those which come from the ground form the nucleus for the early spring broods.

This pest is often accompanied by a small yellow ant which has been seen transporting the aphids to places of safety. It is believed that the distribution of the root forms is thus facilitated by the ants, and they may also aid in getting the aphids to the surface in the spring. The aphids repay the ants for their assistance by secreting a sweet liquid called honey dew upon which the ants feed.

The root forms mostly congregate on the tenderest roots, but some are to be found on all parts of the root system. Many of them still cling to the roots when the trees are dug up, and they are thus often transported great distances on nursery stock. The pest then readily acclimates itself to its new home and soon spreads throughout whole nurseries or orchards.

Above ground the insects attack the swelling buds in the spring, and later their increase in numbers crowd them onto the

twigs and leaves. As each little aphid begins to suck the sap as soon as it leaves the body of the mother, the result of so many hundreds of these little pumps working almost continuously upon both roots and branches must be a speedy check to the growth of the tree.

Methods of preventing the ravages and spread of this pest.—If this pest once gets a good foothold in a nursery or young orchard, it will prove a difficult insect to fight. Those individuals that infest the branches are easily reached and have been found to succumb readily to either Kerosene Emulsion or a strong Decoction of Tobacco.* The emulsion should be diluted with nine or ten parts of rain water, the 3 gallons of the formula thus making about 30 gallons to be used in spraying. This diluted emulsion will probably prove the most effective, although the tobacco has been used with equal success in some instances. Care should be taken in the preparation of either insecticide; many of the reported poor results from the use of insecticides is due to their not being properly prepared and used.

As it is the young trees which usually suffer, either insecticide can be easily applied with a knapsack sprayer or small force pump. Apply in as fine a spray as possible and drench the trees. In rare cases a second application a few days later may be necessary. The best time to spray is in April or May when the branch forms are the most numerous.

The root forms will not be reached by this method, hence the

*To make the emulsion, thoroughly dissolve $\frac{1}{2}$ pound hard or soft soap in 1 gallon boiling water. While this solution is still very hot, add 2 gallons kerosene and quickly begin to agitate the whole mass through a syringe or force pump, drawing the liquid into the pump, and forcing it back into the dish. Continue this for five minutes or until the whole mass assumes a creamy color and consistency which will adhere to the sides of the vessel, and not glide off like oil. It may now be readily diluted with cold rain water, or the whole mass be allowed to cool when it has a semi-solid form, not unlike lopped milk. This stock, if covered and placed in a cool dark place will keep for a long time. In making a dilution from this cold emulsion, it is necessary to dissolve the amount required in three or four parts of boiling water, after which cold rain water may be added in the required quantities.

The tobacco decoction is made by steeping 5 pounds of tobacco stems in 3 gallons of water for 3 hours; then strain and dilute with enough water to make 7 gallons. The decoction is now ready for spraying without further dilution.

relief obtained in this way is only partial. There is on record no experiments in the destruction of this form and we have had no opportunity to make any, but we suggest the use of very liberal quantities of the diluted kerosene emulsion on the surface of the soil over the roots just before or during a rain. This suggestion is based on the results of experiments with a species of White Grub, the larva of *Allorhina nitida*, an insect closely related to the common May Beetles of the genus *Lachnosterna*. The lawns about the Capitol at Washington being badly infested by these White Grubs in 1888, afforded an opportunity to try the effects of a dilute kerosene emulsion applied upon the surface. After applying the emulsion the lawns were thoroughly drenched with water to help carry the oil into the soil. The result was very satisfactory; after a few days the Grubs appeared sick, and a month later no live ones could be found.

If the aphids on the roots of the trees can not be reached by an application of the emulsion as described above, the trees should be removed at once, burned, and the ground left unoccupied for several months or used for other purposes. The insect could thus be starved out as it is not known to feed upon any other cultivated plants except rarely the plum.

In the discussion thus far of preventive measures it has been supposed that the pest has already gained a foothold in the nursery or orchard. However, to many peach growers in the state the pest is as yet unknown, and they will desire to know how they can prevent its gaining a foothold among their trees. Growers who raise all their own trees from pits will not be troubled with the pest unless careless neighbors introduce it on stocks purchased in infested regions.

If it seems necessary to purchase nursery stock elsewhere, and especially in regions known to be infested, it should be quarantined and very thoroughly treated with an insecticide immediately upon its arrival. Dip each tree in either the diluted kerosene emulsion or the tobacco decoction made as described above for use against the branch forms. As the insecticide acts very quickly, the tree need remain in it but two or three minutes. This method it is believed will effectually destroy all aphids that may be on the trees.

Another method which would doubtless be equally effective is

the one used largely in California where the law requires that all trees, plants, cuttings, grafts, buds, seeds, pits, or scions coming into the state shall be disinfected upon arrival. The disinfection is done by fumigating the trees, etc., with hydrocyanic acid gas, a deadly poison. In fumigating, the trees, etc., are placed in an air-tight tent or box, and for each 100 cubic feet of space in the box or tent one ounce of fused cyanide of potassium (58 per cent.), one fluid ounce of sulphuric acid, and two fluid ounces of water are used. The cyanide of potassium is placed in an earthenware vessel, the water poured over it, the sulphuric acid then added, and the box or tent closed tightly immediately and kept closed for at least forty minutes.

Every peach grower should take sufficient interest in the welfare of his own orchard and that of his neighbor to treat in one of the above ways all peach stocks purchased in localities where the pest is known to be present, as in New Jersey, Delaware, Maryland, or Virginia. If this be thoroughly done our peach orchards will have one less serious insect foe to fear. And the growing nursery industry of New York State, which now has nearly 500 acres devoted to peaches, constituting nearly 15 per cent. of all the peach stocks grown in the United States, will not suffer as it would were it known that this pest is liable to accompany the trees sent out.

MARK VERNON SLINGERLAND.



The New Maize (*Zea canina*). Detail of a portion of an ear, full size.

HORTICULTURAL DIVISION.

A NEW MAIZE AND ITS BEHAVIOR UNDER CULTIVATION.

In 1888 the late Sereno Watson of Harvard University received from Professor A. Dugès of Guanajuato, Mexico, some stalks and kernels of a wild corn which was found at Moro Leon about four Mexican leagues north of Lake Cuitzco, near the southern boundary of the State of Guanajuato, in Southern Mexico. The corn was wholly unknown to cultivation, and the natives of the district believe it to be the original source of the cultivated varieties of maize. This opinion is of great interest because the original form of Indian corn is wholly unknown. It is known among the natives as *mâis de coyote*, from the resemblance of the little kernels to dog's teeth. About a half dozen ears, in a cluster, were with the specimens sent to Harvard, each ear about two inches long and bearing a few rows of very small pointed white kernels. The ears and kernels were peculiar in themselves, but the fact that they were borne in clusters attracted close attention. Mr. Watson gave me two or three kernels of this corn, which I planted in a forcing-house in the spring of 1889. One seed germinated, and the plant grew well until it reached a height of three feet, when it was destroyed by an accident. This was probably the first attempt to cultivate this corn. In 1890, it was grown in the Botanic Gardens at Cambridge, having been started under glass. "The season was a long one," Mr. Watson writes, "and there was no heavy frost in Cambridge until near the end of October. The corn, however, was at that time still very green, and the stalks were finally cut and stored under shelter in the hope that the ears would ripen in the stack; but upon very few did any of the kernels mature." The tallest stalks were over ten feet high, with a diameter of nearly two inches. But the most striking peculiarity of the plants was the

abundance of lusty suckers which "grew as rapidly as the main stalk, so that the plants, which had fortunately been placed some feet apart, had the appearance of two 'hills,' one of the two having nine and the other twelve stalks ascending from a common base." The central stalk also branched higher up on its trunk, and these side branches, as also those from the base of the plants, had a tassel upon the end and bore several ears along their length!

The tassel was very large, with drooping branches. Mr. Watson showed me these plants late in the summer of 1890, with much enthusiasm; and it was easy to see that in the robust habit and multiple ears of the plant there were possibilities for the breeding of a new type of corn.

Mr. Watson concluded that this corn is a new and distinct species, rather than the original of the common corn, and he therefore published it* as *Zea canina*, or dog-tooth corn, thus adding a second species to the genus *Zea*.

In 1891, I grew the corn again from the original Mexican samples—which Mr. Watson divided with me—starting it late under glass (May 22), and setting it out of doors June 12, in a heavy clay loam, when about half a foot high. The plants grew vigorously, and ears began to form late in summer, being borne upon strong lateral branches as before. The illustration on page 332 shows a typical plant. It will be seen that six arms or branches spring from the main stalk. A dozen or fifteen ears set upon these arms. The detail drawing in the upper corner shows nearly half of an average ear, full size. These plants appeared to differ from those which I saw at the Harvard Botanic Garden the year before only in smaller size and earliness. The smaller size may have been due to the soil, which was poorer than at Harvard, but I thought I saw a decided tendency towards acclimatization in the plants, and this is now apparently warranted by the results of this year's experiment. Some of the plants did not make lateral arms, but simply sent up a straight almost earless stalk. Perhaps this was due to the fact that the plants were crowded. Some of the plants matured several good ears.

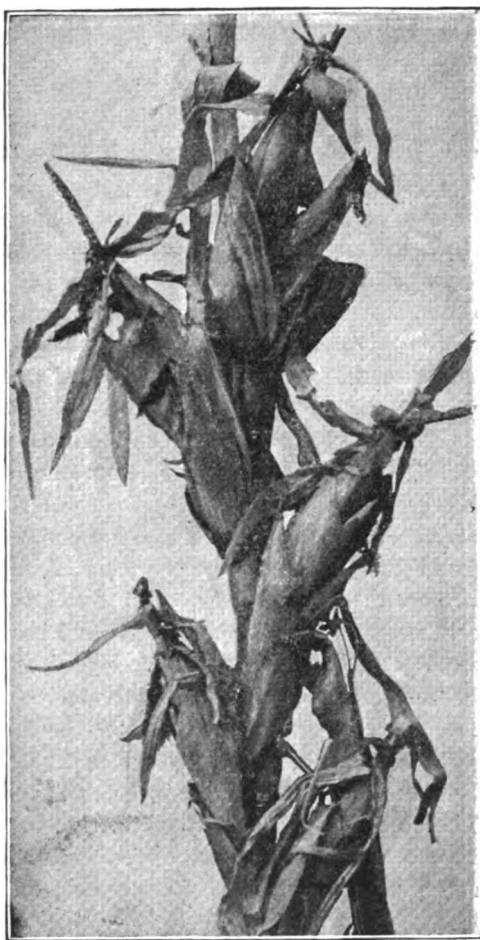
Experiments must now be tried with hybridizations. A cross with the common field corn or sweet corn would perhaps be too

*Proc. Amer. Acad. Arts and Sci. xxvi. 158.

violent. On September 17, 1891, cross-pollinations were made from sweet corn, however, the variety sold as Extra Early Marblehead Sugar. But some less violent cross must be attempted, and another male parent was chosen from the Japanese Striped corn, which is a type grown for ornament and in which the ears and kernels are small. This corn is known in the trade as "*Zea Japonica*." The leaves are striped lengthwise with broad lines of white. The kernels are rounded and yellowish, and the ears are four or five inches long. On September 21 pollen from this Japanese corn was applied to the *Zea canina*, and 17 seeds resulted from this union. From the pollination with the Marblehead Sugar, however, only three kernels were procured, and all were small and weak, and it was doubtful if they would grow.

These seeds were saved with the greatest care and curiosity. They were all sown under glass April 14, 1892. From the 17 Canina $\times$ Japanese seeds, 14 good plants grew, while from the three Canina $\times$ Marblehead seeds, only one grew. All the plants were set near each other in June in heavy clay loam. A few plants of pure *Zea canina* were also set near by. All three lots grew well, but Canina $\times$ Japanese was much the tallest and most vigorous. The one Canina $\times$ Marblehead plant grew scarcely more than four feet tall. Two suckers sprang from the base of the plant, but there were no branches higher up, and all the ears were small and single! The kernels, which had been pollinated from the tassels on the same plant, were indistinguishable from those of true Canina. The only effect of this hybridization with the sweet corn, therefore, was what might have been expected from so violent cross,—a general weakening of the characters of the plant.

The 14 Canina $\times$ Japanese grew with great vigor, reaching a height of eight and nine feet, and nearly all the stalks produced the branches of multiple ears. But the remarkable feature of these plants was the shortening up of these side branches from the length of two and three feet, attained in true Canina, as shown on page 332, to a cluster or brace of four to six ears, as shown on the next page. One plant which produced three stalks from the base, bore four sets on one stalk, five on another, and twenty-five on the main stalk, making a total of 34



Hybrid Corn.—Canina × Japanese.

ears from one seed! A portion of the main stalk of this plant is shown in the illustration. Some plants among these hybrids, however, produced single ears, but the greater number of them made from a dozen to twenty sets, and perhaps half the ears matured. The kernels in these remarkable hybrids are both yellow and white, although yellow is far the most prominent, and they are rounded like the Japanese, but bear a minute point or mucro in memory of their Canina parentage. The ears are twice larger than those of the Canina, from which they came. Two plants of the fourteen had distinctly striped foliage, like the Japanese corn.

The plants of true Canina which grew near by were less branched than the Canina × Japanese, and while most of the ears were multiple, some were single. This corn was also attacked by smut. The behavior of these plants indicate either that Canina is variable or that it tends to lose its characters under cultivation. I am inclined to adopt the latter explanation, especially as another lot of Canina grown in the field alongside a plan-

tation of sweet corn showed similar degeneration to single ears. This latter plantation stood besides the Cory sweet corn. Among this Canina only one plant matured, and that bore short ear-clusters, much like those shown on page 336, and the kernels were large and rounded, showing that it had been crossed with something the year before, probably an accidental mixture with Japanese, next which some of our Canina grew in 1891. The remaining Canina plants were still growing vigorously when frost came October 1, and some of them made the long arm-like branches, but several of them produced few and nearly simple ears. All these Canina plants were from seeds put into the ground June 15, for the purpose of testing their ability to ripen in one ordinary season. Now, the Cory corn alongside this Canina and which was grown from pure seed, seemed to show the effects of the Canina. There were many "rogue" kernels on the ears, being smooth and whitish and suggestive of Canina influence. It is known that maize often shows an immediate effect of pollen. No other corn grew within eighty rods of this plantation.

Our observations seem to show that *Zea canina* is losing some of its characteristic features under domestication, and that hybridization with the Japanese corn promises interesting and valuable results. Hybridization with sweet corn so far promises little in the origination of profitable varieties. It is by no means certain that we can preserve the wonderful prolificacy of the Canina $\times$ Japanese hybrid, but the experiments will be continued. In order to keep the stock straight until we determine if results of a somewhat permanent nature can be obtained, we propose to hold these corns entirely in our own hands for the present.

It may be worth while to enquire if this Canina corn still retains a specific identity, if it really is a distinct species from the common corn, *Zea Mays*. For myself, I am strongly of the opinion that it is not a distinct species. I am rather inclined to think, with the native Mexicans and Professor Dugès, that it is the original form of *Zea Mays*, or at least very near it. It explains many points in the evolution of Indian corn. Some varieties of sweet corn occasionally produce rudimentary multiple ears, and this Canina seems to tend to lose them under cultivation. The tendency of cultivation in all plants is to develop some fruits or

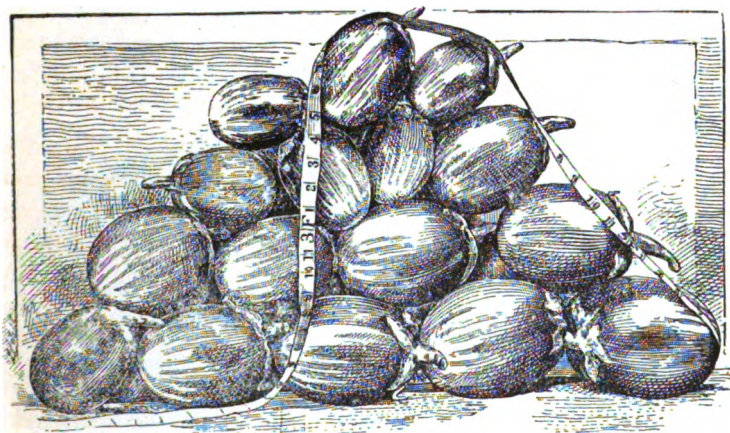
some organs, rather than all fruits or all organs. The suckering habit has been discouraged in the selection of corns. The tendency to sucker, the tendency to produce tassels on the ends of ears, the profuse drooping tassels of many little improved varieties, the predominance of flint corns northward and of dent or pointed corns southward, the occurrence of many curious and aboriginal corns in the Aztec region—all these become intelligible if *Zea canina* is the original of Indian corn.

THE BEHAVIOR OF SOME EGG-PLANT CROSSES.

In 1889, three crosses were made among egg-plants, one cross being between Round White and Black Pekin, one between Giant Round Purple and White Chinese, and the other between Long White and Black Pekin. In every case, the parents were very unlike, both in shape and color of fruit, and in color of plant. A number of plants were grown from these seeds in 1890, and the characters of the resulting offspring were fully explained and figured in Bulletin 26, March, 1891. The present report deals with the second generation, grown in 1891.

The cross which we called A was made between Round White and Black Pekin. The Round White is a small green plant which bears small, oblong, clear white, hard fruits. The Black Pekin is a large, dark purple plant which produces very large, nearly globular and very dark purple fruits. One fruit was obtained in 1889 as a result of crossing these two varieties. The seeds of this fruit gave in 1890 a series of plants which were almost exactly intermediate between the parents in size and other characters. The young shoots were much like the pistillate parent—Round White—but as they became older, the upper surface of the stems, the petioles and the veins of the leaves assumed the purple tinge of the male parent. In form and size, the larger part of the fruits seemed to vary in the direction of the pistillate parent, many of them being decidedly ovoid in form and very small. A few were larger, and had somewhat the form of the staminate parent. Frequently the same plant would produce mature fruits two inches and others five inches in diameter. In

color the fruits were purple while young,—first month or so,—usually dark purple with lighter apex. In some instances this color was retained till time of edible maturity; but as a rule, the dark purple changed to a dull greenish hue, and the light apex became metallic gray with a faint tinge of purple, and streaks of grayish-purple extended towards the base. The accompanying figure shows the extent of variation in 1890, or a fruit of every type obtained.



Extent of variation in the "A" crosses. (1890.)

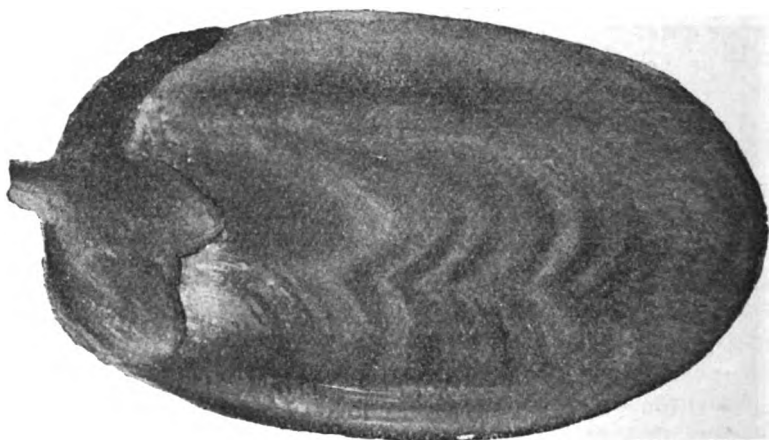
From the first brood of this cross, 1890, eight fruits were selected or again crossed, as parents for succeeding crops. These fruits were essentially alike in color and shape, as shown in the above illustration. These eight fruits, which were the parents of the plants discussed below, were as follows:

- A1. Pollinated with another flower on the same plant.
- A2. Pollinated by Round White (original pistillate parent).
- A3. Pollinated by Black Pekin (original staminate parent).
- A4. Same as A3.
- A5. Pollinated with another flower on same plant, as in A1.
- A6. Same as A5.
- A7. Pollinated by Round White, as in A2.
- A8. Selection, not artificially pollinated.

From these eight fruits, 1405 plants were grown at Cornell in 1891.* The behavior of these plants is indicated by the table

*Duplicates of all these egg-plants have been grown in Maine by Professor W. M. Munson, who will soon report upon them.

which closes this article. It is interesting to note the influence of Black Pekin in A₃ and A₄, into which this variety has twice entered as a staminate parent. All the plants, 203 in number, were purple in foliage and like Black Pekin in habit; and most of the fruits were solid purple, although a few striped fruits still showed the influence of the Round White two generations back. The ones into which the Round White entered twice—A₂ and A₇—do not show so strongly the marks of the double infusion of blood. In A₂, there were a few more plants with green than with purple herbage and the green ones were more productive than the others; these are marks of the Round White, and it may



A Mongrel Egg-fruit. (1891.)

also be said that even the purple plants were of a light cast and that nearly all showed the influence of the dwarf habit of Round White. A₇, the other Round White cross, produced a lot of small plants, but they were unproductive, and much over half of them had purple herbage.

Three of these lots—A₁, A₅, A₆—were from fruits pollinated by a flower on the same plant. These, then, according to popular notions, should produce uniform plants; but with that sublime contrariness which is so characteristic of most of our results of crossing, these lots gave as variable progeny as those which had better right to such possessions. In fact, the lot A₁ was probably the most hopelessly mixed of any in the entire list. The

fruits ranged from pure white to green with white stripes, purple striped, light solid purple, and very dark purple; and the mature fruits varied from the size of an egg to that of Black Pekin. About equal numbers of the 175 plants were green and purple. A5 was nearly as badly mixed, and some plants appeared which had the peculiar spreading habit of Early Dwarf Purple, a variety which had never entered into any of the crosses. A6 showed wide variations also. A8, which was simply a selection and had not been artificially pollinated, was about as variable as the rest.

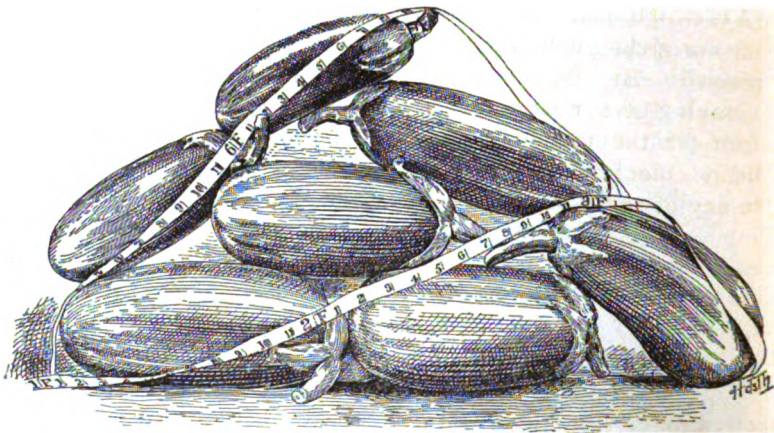
Some of the fruits of these crosses were exceedingly handsome, especially one which appeared in A1 and another in A2. The engraving on last page shows one of them, but no black and white print can do justice to it. White and purple bands were laid on the fruit in alternate waves which seemed to run off the fleshy calyx lobes and to flow down the fruit. Efforts have been made to perpetuate these remarkable types, but they are now lost. Every new attempt at crossing reminds me that the chief value of the operation is the infusing of new vigor into offspring rather than the origination of new types.

As a whole, 543 of the 1405 plants produced perfectly green foliage, showing the effect of the Round White. Most of the fruits produced by these eight samples were of an indifferent and ill-defined color, and were utterly worthless for market. In productiveness, the purple-herbage plants were ahead of the green ones, although the green parent—Round White—is more productive than the Black Pekin. Of the 729 plants which gave sizable fruits before frost, 454 were purple and 275 green. In habit, the A crosses were also very various. The Round White seemed to exert a great influence upon the stature of the plants, but the purple color of Black Pekin appeared to be more potent than the green of the other.

Series B came from a cross of Giant Round Purple and White Chinese. The former has purple herbage and a very large purple fruit, while the latter has green herbage and a long club-shaped white fruit. So far as beauty of form and color is concerned, this series was by far the most promising of the three crosses. The plants in this series, as in the former, were as a rule intermediate between the parents. Much of the vigor of the pistillate

parent' was transmitted to the offspring, but the leaves were smaller and less distinctly lobed.

In form the fruits, as a rule, resembled the staminate parent—White Chinese, but they were of greater diameter. The color at edible maturity was rich dark purple, with lighter apex. When fully mature—that is when left for the seed to ripen—the light purple apex became gray, then yellowish like the staminate parent, while the dark purple body of the fruit became dull green.



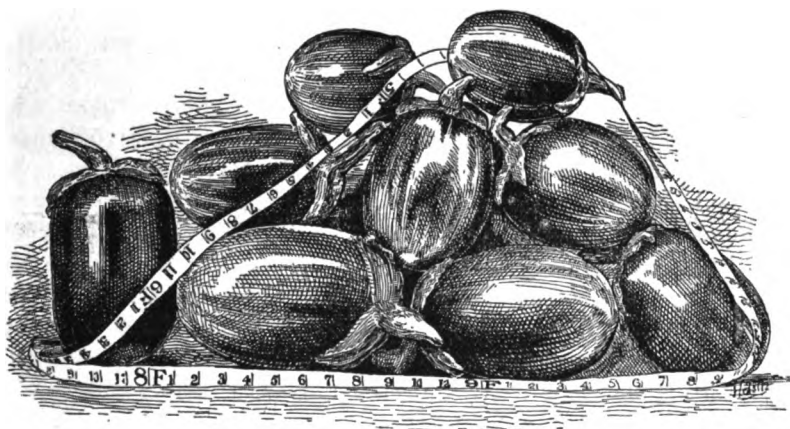
Extent of variation in "B" crosses. (1890.)

The full extent of variation in this series is shown in the illustration. Eight of these fruits grown in 1890 were selected or again crossed for planting in 1891. These B lots originated as follows :

- B1. Pollinated by Giant Purple (original pistillate parent).
- B2. Pollinated with another flower on the same plant.
- B3. Pollinated by Giant Purple, as in B1.
- B4. Pollinated with another flower on same plant, as B2.
- B5. Pollinated by Giant Purple, as in B1 and B3.
- B6. } Selections, not artificially pollinated. These were attractive fruits
- B7. } of a purple color and lighter apex, tending to be striped.
- B8. }

The offspring of these fruits—479 plants—showed a wide variation in color of herbage, many of them being green, although the greater part of them were purple. As a whole, however, these plants were comparative uniform in size and habit, and could be distinguished from the A and C series at a considerable distance.

The plants were low and bushy, but erect, mostly with a grayish-purple tinge when seen in mass. B₂, which was pollinated from another flower on the same plant, gave as various fruits as the others. Of eighteen large fruits of it, one was very black-purple, six were light purple, and one was purple-striped, nine were green-and-white striped, one was pure white. It is strange, too, that one of the plants of this lot had the peculiar habit of Early Dwarf Purple, a variation also found in one of the A series (A₅) which had been similarly pollinated. The lots into which the original pistillate parent, Giant Purple, was again impressed—B₁, B₃, B₅—showed very variable offspring, although there were large numbers of purple and purple-striped fruits in the progeny. B₃ and B₅ were very much alike in habit, color and fruit. There was comparatively little variation in any of the B lots.



Extent of variation in "C" crosses. (1890.)

Series C originated from a cross of Long White by Black Pekin. This series, then, is much like A in parentage, except that the pistillate parent has longer fruit. The effect of the staminate parent in giving color to the foliage was more marked than in series A. In no case was there an absence of the purplish tinge of Black Pekin, and frequently the color was nearly as deep as in the parent. The fruit was of intermediate color, but with the purple predominating. In form, a few of the fruits resembled the

staminate parent ; and many resembled the pistillate parent, while others were wholly distinct.

Four fruits were again crossed or selected in 1890 from this series :

- C1. Pollinated by another flower from same plant.
- C3. Pollinated by Black Pekin (original staminate parent).
- C4. Selection, not artificially pollinated. Seen at the extreme left in the illustration. It was very angular at the ends, purple with a metallic-gray apex.

In these lots, the fruit pollinated from the same plant, C1, gave a variable and very unproductive offspring. C3, into which Black Pekin has gone twice, gave only purple fruits. C4 was the one which we particularly desired to fix, for the original fruit had strong points of merit. This fruit gave us 169 plants, none of which, however, were like the parent, and none seemed to possess superior merits. Only 31 of the plants from it produced fruits before the frost, and of these 5 had green herbage and 26 purple herbage. All the C plants were very tall in 1891, mostly dark in foliage, and late.

The result of all this experiment with secondary crosses and the second generation of primary crosses, numbering 2126 plants, shows that they were exceedingly variable, that pollination from the same plant did not fix the types, that very few novel and promising types appeared, that the white and purple colors tend to unite to produce striped fruits, and that the greater part of the crop was unsalable because of the nondescript colors of the fruits. And all this only emphasizes the fact which we have learned with many other plants, that crossing for the purpose of producing marked novelties for propagation by seed is at least unsatisfactory.

The following table showing the numerical measures of this variation may interest those who are curious concerning plant variability :

VARIATION IN EGG-PLANT CROSSSES.

Samples.	Whole number of plants.	No. with green herbage.	No. with purple herbage.	Whole No. of fruitful plants.	Number fruit-ful plants with green herbage.	Number fruit-ful plants with purple herbage.	No. frts. dark as Black Pekin.	No. frts. light purple.	No. frts. purple-striped.	No. frts. green with white stripes.	No. frts. white.	REMARKS.
A1	175	83	92	92	43	49	8	20	20	28	26	{ Mostly a good lot but very variable. Shows a tendency to revert to Round White; none of the purple plants so dark as in A1. Much like Black Pekin, although there are some green-striped fruits
A2	102	82	21	78	65	13						
A3	86	0	86	68	0	68						
A4	117	0	117	97	0	97						
A5	291	119	172	136	55	81						{ Some plants are low and diffuse like Early Dwarf Purple, but its fruits are different. Plants very various. Plants small and unproductive.
A6	216	89	127	121	54	67						
A7	244	101	143	76	32	44						
A8	174	69	105	61	26	35						
B1	49	—	—	22	2	20	4	4	15	2	0	{ Fruits long, like Long Purple. Mostly tall, but one plant with habit of Early Dwarf Purple. Plants remarkably uniform in size and appearance. Grayish in color, with light purple tinge.
B2	30	—	—	12	8	4	1	6	1	9	1	
B3	96	—	—	36	0	36	0	0	36	0	0	
B4	2	—	—	1	—	—	0	1	0	0	0	
B5	79	—	—	34	0	34	15	15	6	0	0	{ Like B3. Like B3, but plants somewhat smaller. Plants like B6. Like B6 in aspect.
B6	42	—	—	4	1	3	0	0	2	1	0	
B7	73	—	—	6	2	4	0	6	0	2	0	
B8	108	—	—	17	9	8	0	4	5	4	0	
C1	39	—	—	3	1	2	3	0	0	0	0	{ Mostly tall, but occasionally a low plant. Occasionally a low plant
C3	34	—	—	15	0	15						
C4	169	—	—	31	5	26						

FERTILIZERS FOR GRAPE CUTTINGS.

It is often a very serious question with nurserymen what fertilizers they shall use to produce the largest and best grape-vines, especially in the dryer seasons when growth is small. Two years ago we undertook an experiment in this direction, and T. S. Hubbard of Fredonia, N. Y., a well-known nurseryman, gave us 10,000 cuttings of Concord with which to make the test. These cuttings were divided into ten equal lots and each lot was set in the spring of 1891 upon a plot 10x25 ft. The cuttings stood 3x12 inches apart. The plots were arranged in two rows, and they received treatment as follows in 1891 and 1892:

- | | |
|---|---|
| 1. Check
(no fertilizer). | 6. Cotton-seed meal
(4 lbs. a year). |
| 2. Cotton-seed hull
ashes (4 lbs. a year). | 7. Bone flour
(4 lbs. a year). |
| 3. Muriate of
potash (2 lbs. a year). | 8. Stable manure
(40 lbs. a year). |
| 4. Nitrate of soda
(2 lbs. a year). | 9. Bradley's super-
phosphate (4 lbs. a year). |
| 5. Sulphate of ammonia
(2 lbs. a year). | 10. Check
(no fertilizer). |

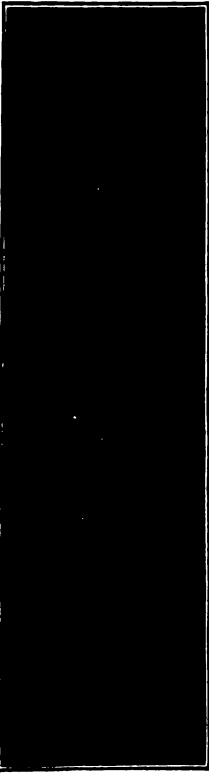
These fertilizers were applied May 14, 1891, and June 23, 1892. They were sown upon the ground and found their way under the surface at the regular hoeings. The soil upon which these cuttings were grown was a poor and very hard gravel. This soil was selected because it had received no fertilizers in recent years and because the results of the different materials would be undisguised by the heavy growth which would be given by a good soil. The early season of 1891 was very dry and many of the cuttings did not start. Later in the season, the remaining plants made a fair growth but no difference could be seen in the plots. It was evident that the fertilizers had not yet reached the roots of the plants. But in 1892 the effect began to be marked early in summer, and it was evident that plot No. 4—nitrate of soda—would distance all the rest. Final observations were made October 19, when it was found that plot No. 4 was best and No. 5 second. These plots gave easily fifty per cent. more growth than any of the remaining eight. No. 2—cotton-seed hull ashes—was the best of

the remaining plots, although its advantage was slight. Between the other seven there were no obvious differences.

Plot 4—nitrate of soda—was conspicuously darker in foliage than any other throughout the season. The vines matured well, although the yellow leaves still hung to the plants in the middle of October. Plot No. 5—sulphate of ammonia—was perhaps ten per cent. below No. 4 in amount of growth, and the wood was not so well ripened as in the other.

THE BLACK-KNOT OF THE PLUM AND CHERRY.

THE NEW YORK LAW.



The black-knot is a serious disease, attacking the branches and twigs of the plum, sour cherries, and sometimes sweet cherries. It is also common upon wild choke-cherries, from whence it spreads to the orchards. The most prolific source of the disease, however, are the neglected hedge-rows of plums and Morello cherries along road-sides and about old buildings. Sometimes black-knot will be noticed sparingly in a community for several years before it seriously attacks cultivated trees, and this fact has caused people to become indifferent to it; but sooner or later it will spread and become a most pernicious evil. Plum growing is abandoned in some parts of the Hudson river valley because of the incursions of black-knot, and a similar fate is likely to overtake any community which neglects it. It is the duty of every citizen to exert himself towards the extirpation of this pest, and New York and Michigan now have laws to compel its removal.

Black-knot.

Black-knot is a fungous disease, and the only reliable treatment yet known is to cut off the knots and burn them. This opera-

tion should be done just as soon as the leaves fall, at the latest. Good plum growers inspect the trees once or twice during the summer if black-knot is feared. Always burn the knots; if they are not destroyed the spores of the fungus will still develop, even after the knot is cut from the tree. The old knots often contain worms, but these only burrow in the spongy tissues; they do not cause the disease.

The following is the New York law. Every citizen should support it:

SECTION 1. It shall be unlawful for any person knowingly or willfully to keep any plum, cherry or other trees infected with the contagious disease or fungus known as the black-knot; that every tree so infected is hereby declared to be a public nuisance, and no damages shall be awarded in any court in this state for entering upon premises and cutting away or severing the diseased part or parts of any tree so infected and destroying the same, or cutting down or removing such infected tree altogether and destroying the same, if done in accordance with the provisions of this act.

§ 2. In any town or city in this state in which such contagious disease exists, or where there is good reason to believe it exists or danger may be justly apprehended of its introduction, it shall be the duty of the supervisor or mayor of any town or city upon the application made in writing and signed by at least three freeholders, who are residents of said town or city to appoint forthwith three competent freeholders, who shall be fruit-growers, of said town or city as commissioners, who shall hold office during the pleasure of said supervisor or mayor, and such order of appointment and of revocation shall be entered at large on the town or city records.

§ 3. It shall be the duty of said commissioners, within ten days after appointment as aforesaid, to file their acceptances of the same with the clerk of said town or city, and said clerk shall be ex-officio clerk of said board of commissioners, and he shall keep a correct record of the proceedings of said board in a book to be provided for the purpose, and shall file and preserve all papers pertaining to the duties and actions of said commissioners, or either of them, which shall be a part of the records of said town or city.

§ 4. It shall be the duty of the commissioners, or any one of them, upon or without complaint, whenever it comes to their notice that the disease known as the black knot exists, or is supposed to exist, within the limits of their town or city, to proceed without delay to examine the trees supposed to be infected, and if the disease is found to exist a distinguishing mark or marks shall be placed upon that part or those parts of every tree so infected, which in the judgment of the commissioner or commissioners should be removed and destroyed, or if in the judgment of such commissioner, or commissioners any tree so infected should be entirely removed and destroyed, then the trunk of such trees shall be thoroughly girdled, and a written notice given to the owner personally, or by leaving the same at his usual place of residence, or if the owner be a non-resident by leaving such notice with the person in charge of such trees. The notice shall contain a simple statement of the facts as found to exist, with an order to effectually remove and destroy by fire the part or parts of every tree so marked and designated, or every such tree entire which shall be so girdled, as the case may be, within ten days from the date of the notice above required. Such notice and order to be signed by the three commissioners, or any two of them.

§ 5. Whenever any person shall refuse or neglect to comply with the order mentioned in the last section, it shall become the duty of the commissioners to carry out the directions of said order, and forthwith to remove and destroy by fire every tree, or part of a tree, so girdled, or marked, as aforesaid, employing all necessary aid for that purpose; the expenses for such removal and destruction to be a charge against the town or city; and for the purpose of such removal and destruction, the said commissioners, their agents and employes, shall have the right and authority to enter upon any and all premises within their town or city.

§ 6. If any owner, or if such owner be a non-resident, then if any person in charge of such trees, neglects to remove and destroy by fire every tree, or part of a tree, so found to be infected, and marked, or girdled, as aforesaid, after notification, and within the time hereinbefore prescribed, such person shall be guilty of a misdemeanor and punished by a fine not exceeding twenty-five dollars or by imprisonment in the county jail not exceeding ten

days, or both, in the discretion of the court; and any justice of the peace of any town or city, in which said offense shall be committed, shall have jurisdiction thereof; and all such fines so collected shall be turned over to the supervisor of said town, or other proper officer, to be placed by him in the contingent fund of said town or city.

§ 7. The commissioners shall be allowed for service under this act two dollars each for each full day and one dollar each for each half day, and their other reasonable charges and disbursements hereunder to be audited, as well as any other charges and disbursements under this act, by the board of town auditors or proper city officers, to be paid to such commissioners as other town or city accounts are paid. Such fees and all reasonable charges and disbursements of said commissioners, in each case may be recovered by the town in the name of the supervisor, and in cities in the name of the city, from the owner of the diseased trees, on account of which such fees, charges and disbursements become payable or were incurred.

§ 8. This act shall take effect immediately.

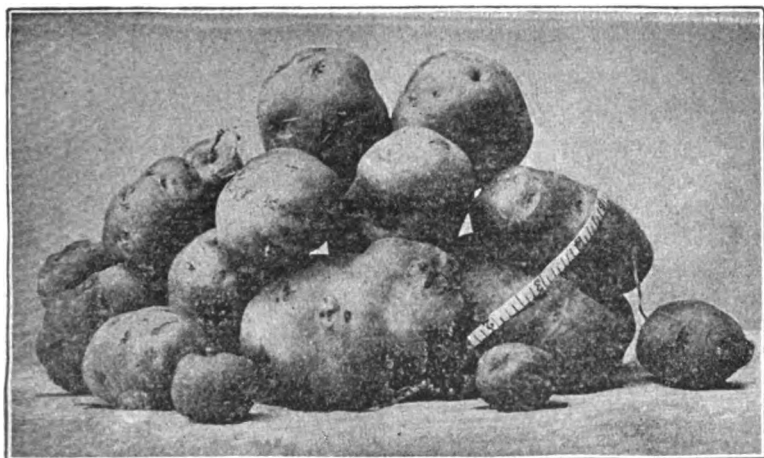
Approved by the Governor, May 12, 1892.

THE WILD POTATO OF THE MEXICAN REGION.

About 1878 Dr. W. J. Beal of the Michigan Agricultural College received from the Harvard Botanic Gardens a few tubers,—the largest about an inch in diameter—of a wild potato from Mexico. This potato has been grown since that time at the Michigan College, and we have grown it here two or three years, from the Michigan seed. The tubers are gradually improving, and in 1887, when I made a report upon this potato,* the best tubers measured three inches in length. The largest tubers now reach over four inches in length, and the number of small potatoes in the hills seems to be lessening. The illustration shows an average sample of this potato as dug in our gardens this year. The tubers are brown, with deep eyes, and tend to be flattened.

*Bull. 31, Mich. Expt. Sta. 87.

They keep well. The flesh is very yellow. When cooked, the flavor is rich and possesses a slight aroma which is not present in the common potatoes. The plants usually produce balls freely



Mexican Wild Potato.

This potato is, probably, the *Solanum tuberosum* var. *boreale* of Gray, although it has the interposed small leaflets which that plant is supposed to lack. It occurs in a wild state from the Montezuma valley, Colorado, to New Mexico southwards in the mountains in Mexico. This wild potato of the north appears to have been first brought to notice in 1856 by Dr. A. J. Myers, of the United States Army, who found it in Western Texas. He sent specimens to Asa Gray, who named it *Solanum Fendleri*, in honor of Augustus Fendler, an early botanical explorer of the Southwest. Dr. Gray afterwards considered it to be only a geographical variety of the potato and renamed it *Solanum tuberosum* var. *boreale*. The account of the plant as seen by Dr. Myers, contains the following reference to the tubers: "The tubers, though small, being rarely as large as a hickory-nut, have been gathered, cooked and eaten by officers and soldiers, and they proved both palatable and innocent." This plant was grown in 1888 by the Colorado Experiment Station from wild Colorado tubers. The tubers under cultivation were "quite large

relatively to the other forms [samples of *Solanum Jamesii*], oblong in shape, and of a dark brown color." * Several crosses were made in Colorado upon this wild potato from pollen of common potatoes, but I am not aware that any subsequent report has been made upon them. The Wild Mexican potato has been grown by several experimenters for a number of years. Their reports would be interesting.

DO FERTILIZERS AFFECT THE QUALITY OF TOMATOES?

There is much discussion concerning the supposed effects of different fertilizers upon the quality—solids, sugar, acids—of tomatoes. Samples of tomato fruits were taken September 6 from various fertilizer plots for chemical examination.† In the following table each entry or sample means a single fruit. The fruits selected were well colored and of medium size and ripe enough for dessert use. All the samples are Ignotum.

The fertilizer plots from which these fruits were taken are of two series. The samples 1 to 8 are from a general test to determine the values of nitrogen, potash and phosphorus, alone and in combination. Six plants constituted a plot, and the fertilizers were sown on the surface June 20. The yields of these plots are shown in Table IV, page 195, of our last tomato bulletin (No. 45).

Samples 9 to 11 are from a series of plots designed to determine the relative merits of single and intermittent applications of nitrate of soda (Tables I, II, III, Bulletin 45). These plots contained 15 plants each. Samples 9 to 9c are from a plot which received a single application of nitrate of soda of 3 lbs. June 20; No. 11 received the same total amount in four applications.

Samples 12 and 12a are from a plot to which a liberal dressing of good, fine stable manure was applied.

The soil in all these plots is a fairly good, dry and high gravelly loam.

*Bull. 4, Colo. Expt. Sta., 14.

†The method of chemical analysis is discussed upon page 301 of this bulletin.

DO FERTILIZERS MODIFY QUALITY OF TOMATOES?

Samples.	Field Treatment.	Selection of samples.	Solids.	Sugar.	Acid.
1	Nitrate of soda, 1 lb.....	3 fruits from 3 plants.....	5.57%	1.41%	.44%
1a	" " ".....	" " ".....	6.07	—	.47
1b	" " ".....	" " ".....	5.72	.94	.57
3	Muriate of potash, 1 lb.....	2 frts. from same cluster.	5.88	—	.38
3a	" " ".....	" " ".....	5.42	—	.37
4	Nitrate soda, 1 lb., Bone black, 2 lbs.....	2 frts. from 2 plants.....	5.26	1.15	.34
4a	" " ".....	" " ".....	6.17	1.47	.59
5	Nitrate soda, 1 lb., Muriate potash, 2 lbs.....	5 and 5a from one plant; 4.97	4.97	.69	—
5a	" " ".....	5b from another plant. 4.90	4.90	.92	.75
5b	" " ".....	" " ".....	5.54	1.22	—
6	Bone black, 2 lbs., Muriate potash, 1 lb.....	2 fruits from 2 plants.....	5.76	—	.44
6a	" " ".....	" " ".....	5.90	1.01	.36
7	Nitrate and Muriate, 1 lb each.....	2 fruits from one plant...	6.49	—	.35
7a	Bone black, 2 lbs.....	" " ".....	6.10	.89	.45
8	Check (no fertilizer).....	2 fruits from one plant...	5.52	1.07	.54
8a	" " ".....	" " ".....	5.40	—	.38
9	Nitrate soda.....	9 and 9a from one plant; 5.71	5.71	—	.44
9a	" " ".....	9b and 9c from another 3.89	3.89	.97	.58
9b	" " ".....	plant..... 5.77	5.77	—	.39
9c	" " ".....	" " "..... 5.58	5.58	—	.33
10	Check (no fertilizer).....	" " ".....	6.56	.58	.44
11	Nitrate soda, applied June 20, July 21, Aug. 8, Aug. 26.....	" " ".....	6.04	—	.72
12	Stable manure.....	2 fruits from 2 plants.....	5.91	—	.51
12a	" " ".....	" " ".....	5.97	.90	.37

It is plain from these figures that there was no uniform variation in the quality of the tomatoes. The differences are as wide between different fruits of the same plot as between the different plots. The variations in sugar in the samples from the same plot are well shown in 5, 5a and 5b, in which the readings run from .69 to 1.22. We hope to repeat the experiment the coming season.

THE VETCH OR TARE AS AN ORCHARD PLANT.

Orchard lands are nearly always benefited by some cover or mulch during a part of the year, especially during fall and winter. One of the values of sod lies in the protection to the soil, but a sod cannot be obtained in a single season. If orchards can be cultivated in spring and early summer and then protected with some growth which will shade the soil and keep it moist during the remainder of the warm weather and afford some protection from frost during winter, the best results will undoubtedly be obtained, as a rule. This cover crop should also afford fertilizing materials to the soil when turned under, and greatly improve the mechanical character of the soil, as well.

The leguminous plants—those belonging to the clover family—at once suggest themselves because they are rich in nitrogen, and may therefore serve both as cover and fertilizer. We have tried mixed beans and field peas, but there are objections to both, although either one is probably better than weeds or bare ground. This year we have tried the European vetch or tare (*Vicia sativa*), seed of which we obtained of J. M. Thorburn & Co., New York. This plant is grown for forage in England. A half bushel of seed was sown June 16 upon five-eighths of an acre of heavy clay loam. It was sown broadcast upon a freshly prepared surface, and well dragged in. The seed could have been sown later with equally as good effect, no doubt, and the cultivation of the orchard could have been continued for ten days or two weeks longer. The young trees of pear, plum and apricot have made an excellent growth this year among the vetch. The vetch started

somewhat slowly and the seeding seemed to have been too thin ; but by the middle of September the ground was covered thickly. Frost came October 1, but the vetch was not injured and it continued to grow until the middle of the month, and remained green still longer. It made a remarkable cover, growing knee-high in a dense mat and everywhere completely covering the ground. It began to flower in September, but no seeds ripened except upon a few poor spots. Upon light soils, seeds would probably form freely, but the plant is an annual and is not likely to become a weed. The roots do not extend deep. With the approach of hard freezing weather, the stalks fell upon the ground, where they now lie like a thin even covering of old hay. The stems are soft and can be easily plowed under in spring and will soon decompose ; and they will not keep the soil wet too late in spring, which is an important point upon clay soils. On the whole, we are much pleased with the vetch as an orchard plant, and shall use it again.

Samples of this vetch, including four to six inches of the roots, gave the following fertilizer analysis :

	Original substance.	Dry substance.
Nitrogen.....	.65 per cent.	5.10 per cent.
Phosphoric acid (P_2O_5)	.146 "	.70 "
Potash (K_2O).....	.475 "	2.28 "
Water	79.15 "	

Compared with clover, the fertilizer value is high. The following are summaries of several analyses of red clover :

	Dry substance.
Nitrogen.....	2.05 per cent.
Phosphoric acid.....	.66 "
Potash	2.24 "

SUBSTITUTE FOR GLASS IN GREEN HOUSE ROOFS.

There is much inquiry for some cheap substitute for glass for greenhouses, and various preservative preparations are recommended for the treatment of cloth and paper to be used in roofing. We have tried paper one season and cloth two seasons, and find both to be entirely unsatisfactory for winter roof in this climate. They are cold, dark, and not durable. For summer or late spring use, oiled muslin is fairly satisfactory. Plants which require a

heavy shade in summer can be grown to advantage under such a roof. In the summer of 1891 we found a cloth-roofed house to be an excellent place for flowering the tuberous begonias. Cloth roofs, with ordinary oil treatment, last less than a year, and paper is so easily torn and punctured by drifting twigs that we consider it nearly useless for roofs. It will also tear after a short time by a heavy wind from the inside if a door or ventilator chances to be open. The cost of a few annual roofs of this character will pay for a glass roof. Even if the cloth were to last for two or three years, it would soon become very dark from a collection of dirt and the growth of mildew.

Our first experience with these covers was the use of paper in the fall of 1890. The paper used was a thin white, stiff, architect's drafting paper known in the trade as "Economy." This was laid over the sash-bars and was held down by the caps used for holding butted glass. It was then thoroughly saturated with raw linseed oil. It had been in place but a short time when an ambitious cat attempted to walk over it, and made a hole at about every other step. After a few weeks of vexation, the paper was removed, and a medium quality of unbleached muslin cloth was substituted, being laid on in the same way. This muslin was oiled twice with raw linseed oil. This was in December. The cloth lasted until late spring, but became very black and dirty towards the last. In the fall of 1891, another covering of the same muslin was laid, and this received three coats of raw oil. This lasted until the next summer.

This roof is now covered with glass.

L. H. BAILEY.

Bulletin 50.

March, 1893.

Cornell University Agricultural Experiment Station.

ENTOMOLOGICAL DIVISION.

THE BUD MOTH.



By MARK VERNON SLINGERLAND.

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BULLETINS OF 1893.

50. The Bud Moth.

FOUR NEW TYPES OF FRUITS.

New types of fruits are nearly always misjudged. They are compared with the most similar type of well-known fruit, even though the two may be very unlike. It should be remembered that wholly new types of fruits are not to be measured by existing standards. They are not introduced, as a rule, for the purpose of supplanting other fruits but with the intent that they shall add variety to our fruit-lists, and occupy places which are now vacant. If they fill an unsupplied demand or if they create a new demand, then they may be counted successful. It is often said of the Crandall currant, for instance, that it can never supplant the common currants and is therefore worthless. It is true that it can not compete with our present currants, but it may fill a place in the market or in the home demand which no other fruit fills; if so, it is worthy, and we shall grow it at the same time that we increase the plantations of red and white currants. The following new types must ultimately stand or fall upon their own intrinsic characters.

It must also be said that new types of fruits and vegetables usually suffer from injudicious praise. Their merits are so much exaggerated that great disappointment results when the varieties come to be known, even though they really possess commendable features. Catalogue descriptions are so often overdrawn and colored beyond the point of belief, that they create a presumption against the novelty in question in the minds of intelligent persons. Novelties are often short-lived because of this disappointment which follows excessive praise; while if the same varieties had been introduced quietly and with candid descriptions, they might persist and eventually become acquisitions to our horticulture. Few fruits have suffered more from this unwise applause than the four which I am about to discuss, and I feel that I must create a wholly new basis of criticism before I can command the attention of careful men.

trouble is recent shows that no fungus is present, and in fact there is no ground for the causal connection of any parasitic organism. Immediately beneath the periderm the young phellogen tissue at the points of the blisters is seen to be very greatly elongated radially. This radial elongation of the phellogen causes the periderm to be raised in the form of a blister. Beside the radial elongation of the phellogen cells they are also very much distended. This distension continues until the cell walls are no longer able to stretch because they become so thin that they break and the cells collapse. This collapse of the phellogen cells causes the collapse of the blisters and in drying these affected areas are depressed below the normal surface of the twig. Also the dying tissue forms a nidus for such saprophytic fungi as the *Fusarium* which was in many cases present. This dropsical swelling of the tissues is of the same nature as that which occurs sometimes with tomatoes when grown under conditions which favor rapid and continuous root absorption and at the same time hinder transpiration, or growth. A thorough study of this trouble with the tomato was made last winter by the author and published in Bulletin No. 53, May, 1893, of the Cornell Station. To this the reader is referred for a full discussion of the unequal operation of the physiological laws which induce the trouble, and for the bibliography.

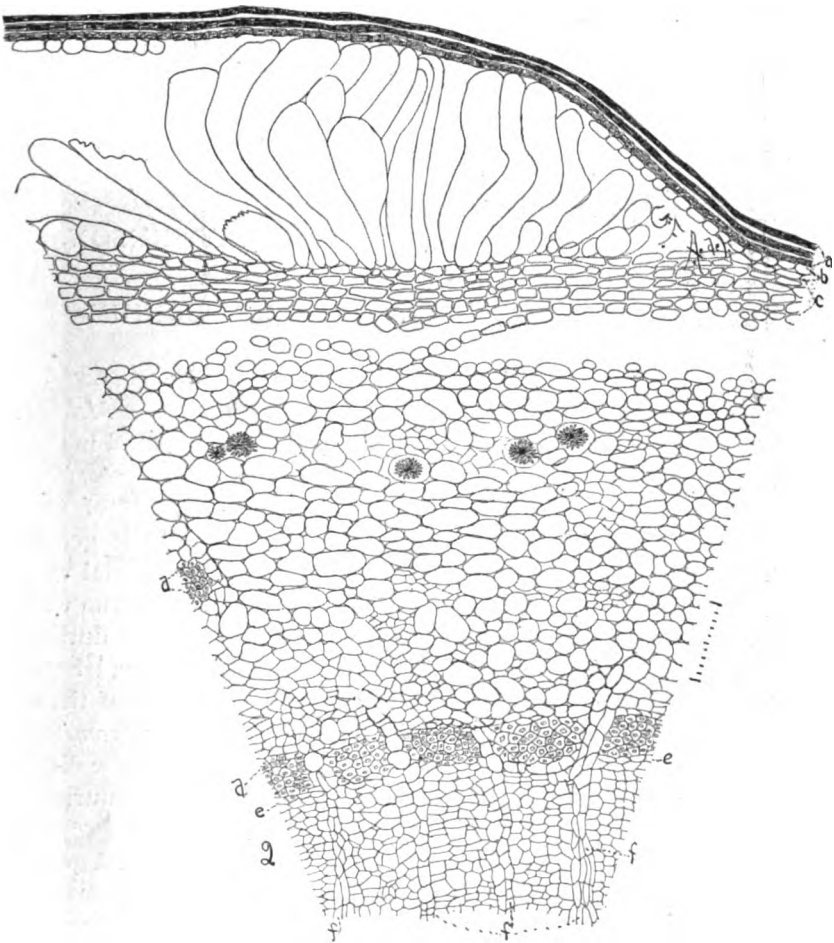
In the case of the tomato *œdema* the unequal operation of the physiological laws was due to certain unfavorable conditions of greenhouse lighting and heating. This would not apply to the case of the apple trees which were grown out doors. But since the trouble was like in kind the cause would probably be found in some condition of soil, cultivation, or pruning of the trees, which would favor root absorption and hinder transpiration, or growth at a sufficient number of points on the tree to take charge of all the water which the roots absorbed. Inquiry of the owner developed the fact that the soil in the young orchard was very fertile and well worked, and that the conditions so far as soil was concerned were very favorable for rapid root absorption and growth. In fact the trees grew very luxuriantly and were the marvel of the neighborhood. But during the winter and early spring they were very severely pruned. According to the owner



FIG. 1.—*Edema of Apple Trees.*



FIG. 3.—*Melanconium fuligineum*.

FIG. 2.—*Edema of Apple Trees.*

they were pruned very close, leaving only the main limbs and twigs and a few secondaries, and the new growth was cut back one-third. This left but few growing points. When root absorption and growth began in the spring, there being no leaves to discharge the excess of water through transpiration, the few growing points could not dispose of the excess. Consequently the thin walled phellogen tissue could not stand the strain. Figure 2 represents a portion of a cross section of one of the blisters;

a, periderm; *b*, phellogen; *c*, inner layer of cells developed from phellogen; *d*, bast fibers; *e*, cambium; *f*, medullary rays. Scale = 1 mm.; object magnified 10 times more than the scale. Drawn with aid of camera lucida.

The cause being known the remedy would be suggested to all, that too vigorous growth should be guarded against and too severe pruning should not be indulged in.

GEO. F. ATKINSON.

ARTIFICIAL CULTURES OF MELANCONIUM FULIGINEUM.

The suggestion made by Miss Southworth* that the *Melanconium fuligineum* (Scrib. et. Viala) Cav., should be placed in the same genus with the Ripe Rot of grapes and apples (*Gloeosporium fructigenum*, Berk.) led me to make artificial cultures of the fungus for the sake of comparison with cultures of the genus *Gloeosporium* of the same type as the *fructigenum*. Material was obtained from Mr. F. S. Earle of Ocean Springs, Miss., who was kind enough to take the trouble to collect some fallen grapes during the month of February, 1893, from a vineyard which had been affected with the fungus the previous season. A few of these grapes possessed numerous pustules characteristic of *Melanconium fuligineum* and which were filled with spores. With these dilution cultures were started in Petrie dishes using ordinary nutrient agar.

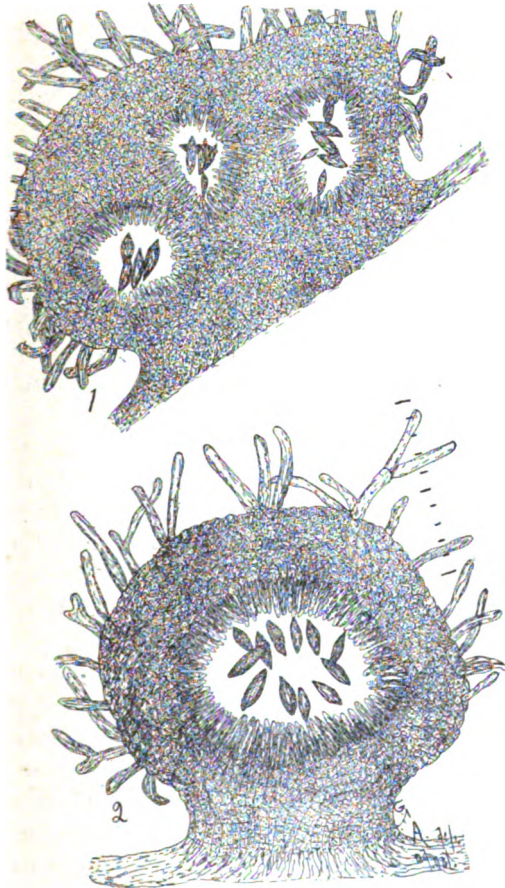
In 24 hours the spores were germinating. One to several germ tubes may arise from the spore, usually several. The spores remain continuous, and at first the threads develop septa scantily or indistinctly. The hyphae soon branch and usually profusely quite close to the spore, so that a rudimentary stroma appears to be developed quite near the center of growth. The spores germinate quite readily in the nutrient agar and growth continues readily for a few days, but no spores were developed in the plate cultures even after a period of three weeks. Even after the first few days the fungus no longer grew vigorously. The nutrient

*Journal Mycology, Vol. VI. No. 4, 1891, p. 171.

agar did not supply the needed kind of nourishment for it, or lacked favorable physical properties.

A few of the colonies of the threads known to have originated from spores of the *Melanconium fuligineum* were transplanted to culture tubes of nutrient agar, but in a month's

time seemed to make no growth or but very little. At the same time several colonies were transplanted to sterilized bean stems in culture tubes. This medium proved to be very favorable for the organism, for in a few days a profuse growth appeared at the point of the transplantings. The threads of the fungus grew both within the tissues and upon the surface of the stems. In macroscopic appearance the surface growth first formed a scant downy, whitish weft with a number of ascending and procumbent threads at the advancing edge of the weft. From the center of growth this was soon succeeded by a darkening of the fun-



FIGS. 1 AND 2.—*Melanconium fuligineum*.

gus, brought about chiefly by the discoloration of the threads lying close to the substratum, and the appearance of stroma or stools scattered over the surface which gave the stem a punctiform

appearance. This growth spread until the entire surface of the stems so far as the moisture extended presented a blackened or charred aspect, studded with numerous black points. The fungus also grows out upon and in the infusion in which the stems are partly immersed, and in time forms a thick web.

The elevated stools when magnified simulate in form a pezizoid stroma, being attached to the substratum by a very short stem, and presenting a plane or convex surface, their perpendicular diameter being less than their horizontal diameter. These stools perform the same function in the artificial cultures that the pustules on the berries do, and produce myriads of fuliginous navicular spores. The superficial position of the fruiting stroma is probably due to the difference in the substratum. Sometimes the spores are borne upon the surface of the dark stroma, or very frequently the stroma forms a pseudo-pycnidium covered with loose threads some of which bear spores, but the center is occupied by a hymenium from which numerous basidia converge toward the center of the cavity and bear multitudes of the characteristic spores, as shown in figures 1 and 2. When the stroma attains some size there may be several cavities at different relative depths.

When the cultures in the Petrie dishes were about one month old the plates were photographed and plate No. 3 is reproduced in figure 3. Since this was a dilution culture for the separation of the fungus the culture is a mixed one and other colonies than those of the *Melanconium fuligineum* appear in the plate. Up to this time in the agar the colonies remain colorless. The growth in dilution culture No. 3 where the fungus had more room did not exceed 1 cm. in diameter, and while the growth was quite compact, radiating threads are shown on the margin of the colony. In the photograph the colonies of *Melanconium fuligineum* are those of the medium size and the places from which the transplantings were made can be readily seen. In the illustration beside the *Melanconium* are common moulds, bacteria, and a dark yeast form which produces deep black points in the medium.

Compared with cultures of the type of *Gloeosporium fructigenum* which has fallen into my hands, the *Melanconium fuligineum* seems to be generically distinct as shown by the characters of germination, the growth in the agar plate, and the characters of

fructification on a more solid artificial substratum like sterilized bean stems. A full comparison it does not now seem best to make, reserving it for the study of the *Gloeosporium*s which are now in progress. Figures 1 and 2 drawn with aid of camera lucida; scale=1mm.; object magnified 30 times more than scale.

GEO. F. ATKINSON.

POWDERY MILDEW OF CRUCIFERS.

A powdery mildew of certain cultivated cruciferous plants is probably of common occurrence in America, but thus far it does not seem to have attracted much attention. This may be because it is not very injurious. At present this mildew is known only in the conidial stage, on crucifers, and I do not remember ever seeing any reference to its occurrence on these plants in the United States. It frequently becomes very injurious to turnips in England where it has been known for some time. W. G. Smith records it in his little book, "Diseases of Field and Garden Crops" under the name of *Oidium balsamii*, Mont.

Oidium is a form genus which includes several species that are known to be the conidial stages of some pyrenomycetous fungus especially of the group *Erysipheæ*. According to Saccardo several of the microsporous species are probably more properly referable to the genera *Ovularia* and *Ramularia*.* Several of the larger species of *Oidium* have already been correlated with their ascosporous form.

Oidium balsamii, Mont. was named from specimens of the mildew on *Verbascum montanum* collected at Milan by Balsamo and referred by him to *Oidium tuckeri*. Berkeley† first published the species using Montagne's manuscript name, and recorded its occurrence in England on *Verbascum nigrum*, and also to this species referred the mildew which was at one time abundant and injurious upon the Culhill's Black Prince Strawberry in the Kew Gardens.‡ In 1880 it appeared in abundance in England on tur-

* See Syll. Fung. Vol IV, p. 41.

† Ann. Nat. Hist., Vol. XIII. 1854, p. 463.

‡ Gard. Chron. Apr. 15th, 1854, p. 263.

nips* for the first time though it had been observed there before that time.

During the autumn of 1893 the present writer observed it on turnips, Japanese cabbage and Scotch green curled kale at Ithaca, N. Y., and in the autumn of 1889 at Auburn, Ala., upon ruta bagas.

The turnips did not seem to be very much injured though in several cases large areas of the surface of the leaves were white with the mildew. In many cases the Scotch kale leaves were completely covered on both surfaces with the growth, and in such cases must produce considerable injury. The Japanese cabbage which was affected was going to "seed," and not only were the leaves affected but several of the fruiting stems were completely covered by the fungus. Several *Erysiphe* which fruit shyly on the leaves of their hosts frequently do so abundantly on the stems and it was hoped that in this case the perfect form of this *Oidium* might be obtained, but thus far no sign of the ascosporous stage has been seen. It would be difficult to properly correlate the form without the evidence to be derived from this stage, but there is some evidence to be gained which at least suggests relationship to some species. As I have found, the haustoria on the mycelium are lobed. It is quite possible that the form is ultimately to be referred to some of the species of the genus *Erysiphe*. As DeBary† has pointed out the haustoria on the mycelium of *Erysiphe galeopsidis* are lobed and this character is useful in differentiating this species from *Erysiphe cichoracearum*. No species of *Erysipheæ* have as yet been recorded upon any of the cruciferous family. If the *Oidium* on turnips has been properly referred to the *Oidium balsamii* on *Verbascum* then there would be some probability at least that this was the conidial stage of *Erysiphe galeopsidis*, since that species has been found upon a genus of the *Scrophulariaceæ* (*Chelone*). In size and form the Conidia of *Erysiphe galeopsidis* agree very well with those of the turnip mildew. But this evidence can only suggest, not determine, the true relationship.

GEO. F. ATKINSON.

* Gard. Chron. XIV, 1880, p. 392.

† Morp. und Phys. d. Pilze, III p. 49.

AGRICULTURAL DIVISION.

WHEAT CULTURE BY THE JETHRO TULL OR LOIS-WEEDON SYSTEM.

Since to the investigations and practices of Jethro Tull is due more than to any other cause the superior culture given to roots and grain crops in England, it may not be out of place to state briefly the chief points of his system.

Jethro Tull, an English landlord educated for the bar, visited Italy and the South of France at the close of the sixteenth century in order to regain his health. In these countries he learned that many successive crops were taken from the land without any apparent diminution of yield. He says, "Vines kept in the condition of low shrubs are constantly plowed (cultivated) in the proper season; these have no other assistants, but by hoeing, because their heads and roots are so near together that dung would spoil the taste of wine they produced, in hot countries."

From what he had seen and learned during his visits he conceived the following propositions:

1. "That interculture among the growing crops is a necessary preparation in well conducted farming."
2. "That adequate tillage is not only an economic substitute for manure, but"
3. "Thorough tillage is also competent, with or without the aid of manure, to secure the profitable growth of any given species of cultivated plants, year after year, in succession." He began to raise wheat much as we raise corn, in drills, with intervals wide enough for the passage of the horse hoe. The rows of each succeeding crop of wheat were planted in what had been intervals the year before.

Up to the time of his death, in 1741, he had grown thirteen unmanured wheat crops without intermission, and without decrease, in the same ground. In the latter years of his practice he frequently grew a hundred acres of wheat in one season by his improved method of horse hoeing.

Rev. Samuel Smith adopted Tull's plan with some improvements and modifications at Lois-Weedon, Northamptonshire. He was extremely successful and hence the system of horse hoe culture for wheat and other similar grains is often known as the Lois-Weedon system.

Smith succeeded in growing twelve successive crops of wheat without the application to the soil of any manure whatsoever, and he claimed that no degeneration or diminution of quality ensued. Many experiments similar to those conducted by Smith and Tull have been carried on in the United States always with satisfactory results so far as the yield was concerned, but with high priced labor, and cheap virgin soil it has been found in most cases unprofitable to practice, in any large way, the Lois-Weedon system of wheat culture in its entirety.

LOIS-WEEDON SYSTEM OF AGRICULTURE MODIFIED.

The experiments were begun in 1874. The previous year the land had raised a crop of oats, without manure, and in 1872 and for several years previous to that date had been in blue grass pasture.

The land after removing the oat crop of 1873 was in a bad lumpy condition. It was summer fallowed in 1874 and not manured. The plots were $20\frac{2}{3}$ rods long and the entire area was cut into 8 strips of $\frac{172}{1000}$ of an acre, each strip being $5\frac{1}{2}$ feet wide.

The first year of the experiment every other strip was drilled to wheat, and the intervals cultivated, the following year the treatment was alternated; the ones having borne a crop of wheat the previous year being under summer fallow. Clawson seed wheat at the rate of two bushels per acre was used in all cases.

Yield 1st year, 1874-5, season poor, 158 lbs., at the rate of 10 31 bu. per acre.

"	2d	"	1875-6,	"	fair,	369	"	"	"	35.77	"	"
"	3d	"	1876-7,	"	sup'r,	694	"	"	"	67.23	"	"
"	4th	"	1877-8,	"	fair,	637	"	"	"	61.42	"	"

It should be noted that the strips are very narrow, only one width of the drill being used, the intermediate spaces between these drilled plots were cultivated four or five times each season.

The effect of using such narrow plots was to allow the wheat

to virtually occupy the whole land, as the culture between these narrow plots was by the common single one-horse cultivator, this permitted the roots to extend and feed upon the plots which were left vacant. At harvest time the whole area had the appearance of a continuous field of wheat, as the heavy heads leaned over into the spaces, and shaded and covered the whole ground. Note that these experiments were conducted somewhat differently from those which are reported below.

No manure or fertilizers of any kind were used during the four years of the experiment. If it is allowed that the wheat occupied all the ground, the yield would be just half as much per acre as is stated above. Even then the yield was large considering the quality of the land. Each year as the experiments went on the land became more friable and in better condition physically than it was at the beginning. The wheat was removed from the field as soon as it was cut, and the ground plowed the same or the following day. This gave the plots which had produced the wheat, a short summer fallow from the middle of July until fall, the same year; a summer fallow from the last of May to the first of September the following year. This, as it will be seen, was really "maneuvering" the land, thus causing it to increase in production by culture.

In 1888 a system of experiments similar to those recorded above, with additional plots treated with fertilizers and farm manures were begun.

These plots were located in the same field, but not on the same ground used in the preceding experiments, upon ground where for some seven or eight years experiments had been going on in the cultivation of Indian corn. The plots of Indian corn were narrow and laid lengthwise of the field so when the field was laid off for conducting the experiments in wheat it was seen to be best to lay the plots cross ways of the corn plots, because there had been variable and different treatments in the cultivation of the corn. Some plots had received nothing, others liberal applications of fertilizers. By laying out the plots at right angles to the old ones it at least made them all alike, though one portion of the plot might be quite different in fertility from another portion. The plots contained $\frac{1}{16}$ of an acre each, and were separated by

strips of grass $3\frac{1}{2}$ feet wide. Later the grass was plowed up and the unoccupied strips were kept clean throughout the summer by frequent cultivations.

The primary object of the experiment was to show the value of superior culture on rather poor clay land, such as is frequently found in the wheat districts of New York, and to determine if possible how much of the plant food of the land can be secured profitably without adding any fertilizers. The fitting of the land for most crops is done so badly that it was thought best to not only emphasize the value of culture but to discover if in some part at least, culture might be substituted for expensive commercial fertilizers.

These being the chief objects of the investigation, it will be necessary to speak but briefly of the manured and fertilized plots.

The manured plot received the first year two tons and in all subsequent years one and one-half tons of mixed horse, cow and sheep manure which had been kept in a covered yard during the winter and until the last of May, when it was removed to a rotting pit in the open field from whence it was taken in September to the plots and spread on the surface of the plowed ground. The manure contained a high per cent. of nitrogen owing to the liberal use of cotton-seed meal in feeding the animals. After the first year the wheat had a tendency to lodge, which tendency became so bad in the last year of the experiments that in the Fall of 1892 no manure was used. On plot 3, 60 lbs. of Bradley's superphosphate were drilled in with the seed in the first three years, in the fourth, 60 lbs. of Small's superphosphate, and in the fifth, 15 lbs. of double superphosphate, 15 lbs. of sulphate of potash and 10 lbs. of sodium nitrate. Briefly stated it may be said that the plot received annually 45 lbs. of phosphoric acid, 15 lbs. of potash, and 15 lbs. of nitrogen per acre.

Plot 4 which was in wheat without any "rest" by means of a summer fallow was plowed, as were all the plots immediately after harvests, harrowed, rolled and cultivated several times making indeed a short summer fallow.

All plots contained $\frac{1}{10}$ of an acre each. Two plots were used in the Tull or summer fallow system, so a crop was harvested on each every other year, while in all other cases a crop was harvested every year.

I. Summer fallowed.				II. Farm yard manure.		
Year.	Tull system modified.		Bushels per acre.	Wheat. Lbs.	Straw and chaff. Lbs.	Bushels per acre.
	Wheat. Lbs.	Straw and chaff. Lbs.				
1889.....	213	397	35.35	218	372	36.33
1890.....	208	553	34.66	176.5	552.5	29.41
1891.....	213.5	856.5	35.58	159	719	26.5
1892.....	132.5		22.08	103		17.16
1893.....	175.3	274.7	29.21	82.2	187.8	13.7
Totals.....	942.3	2063.2		738.7	1831.3	
Average..	188.46	515.8	31.41	147.76	457.8	24.62

III. Fertilizer.				IV. Nothing.		
Year.	Wheat. Lbs.	Straw and chaff. Lbs.	Bushels per acre.	Wheat. Lbs.	Straw and chaff. Lbs.	Bushels per acre.
1889.....	193	367	32.16	196	374	32.66
1890.....	194	446	32.33	215	533	35.83
1891.....	123	207	20.5	139	246	33.16
1892.....	121.5		20.25	139		32.16
1893.....	88.9	201.1	14.81	79.8	108.2	13.3
Totals. ...	720.4	1221		768.8	1261.2	
Average..	145.08	305.3	29.01	153.76	315.3	30.75

CONCLUSION.

From these and many other similar experiments conducted in Europe, it is believed that on strong or clayey lands it is often more economical to secure available plant food by culture than by the purchase of fertility.

That in strong wheat soils there is more plant food than the variety of wheat grown can utilize, though enough may not be available to produce a maximum crop.

That in our changeable climate the wheat plant is so handi-

capped at times for want of suitable climatic conditions, that it is unable to appropriate much of the available plant food in the soil and hence is often not benefited by additional nourishment.

That the plants were unable to elaborate more food than the amount furnished by the soil under the superior culture.

That under certain conditions even a moderate amount of manure or fertilizers may not only fail to increase the yield but may be postively injurious to the crop to which they are applied.

I. P. ROBERTS.

CORN—DETASSELING.

July 14, 1893, three plots were marked out in the University corn fields for experiments in detasseling. Plots I and II were side by side in a field of well drained gravelly loam and the corn early and uniformly good. Plot III was on a clay knoll in a field of late corn that suffered severely from the drouth during the latter part of the season. All plots were surrounded by corn that had not been detasseled. Plots I and II contained 16 rows each and plot III 9 rows; each row contained 15 hills. In plots I and III the tassels were removed from alternate rows, while in plot II every fourth row was left with tassels on, that is the tassels were removed from the first three rows, left on the fourth, removed from the next three and left on the eighth row and so on throughout the remaining rows of the plot.

The tassels were removed by hand by pulling them out as soon as they appeared. This operation was performed quite rapidly as comparatively little force was necessary to cause the stalk to break just above the upper joint and without any injury to the leaves whatever, if done before the tassels had become fully expanded. From the experiments in detasseling made at the station it is thought to be of prime importance to completely remove the tassel before it has expanded and commenced to shed pollen. As the tassel at this time is partially protected, within the folds of the leaves, it can only be completely removed by grasping the top of the tassel and giving it an upward pull which causes it to break off as described above. Experiments in detasseling have been made at other experiment stations where the practice has been to

remove the tassels by cutting them off with a corn knife which would either cause an injury to the leaves or a delay until the tassels had become fully expanded and had shed pollen, as some tassels will shed pollen while yet partially protected within the folds of the leaves. In either case a benefit ought not to be expected from the practice. Our experiments show that the object of removing the tassels is not accomplished if they are allowed to remain until fully expanded and become polleniferous.

The following tables give the results of the practice from each of the three plots :

PLOT I.

Row.	Tassels.	No. of stalks.	No. of abortive ears.	No. of good ears.	No. of poor ears.	Wt. of good ears.	Wt. of poor ears.	Wt. of stalks.
1	off	65	20	40	23	17.5	5.5	36
2	on	61	13	36	14	14.5	4	35
3	off	67	16	29	31	13	7.5	38
4	on	63	20	26	18	13	5	40
5	off	72	27	30	29	14	7.5	38
6	on	80	21	28	23	13.5	6	41
7	off	65	17	28	28	13	6	32.5
8	on	73	22	25	26	10.5	6.5	38.5
9	off	70	17	39	12	17	3	34
10	on	69	18	36	16	16	4.5	38
11	off	67	19	32	29	15	7	33
12	on	66	19	38	17	18	4	39
13	off	68	25	30	28	14	7	40
14	on	66	17	29	17	12.5	4	35
15	off	63	21	30	23	13.5	7.5	38.5
16	on	82	18	30	27	12	5.5	40
Total off.....		537	162	258	203	117	51.	290
Total on		560	148	248	158	110	39.5	306.5
Average off.....		67.1	20.2	32.2	25.4	14.6	6.3	36.25
Average on.....		70.	18.5	31.	19.75	12.7	4.9	38.31

Yield per acre, tassels off, 5000 lbs

Yield per acre, tassels on, 4449 lbs.

Gain by removing tassels, 12.4 per cent.

PLOT II.

Row.	Tassels	No of Stalks.	No. of abortive ears.	No. of good ears.	No. of poor ears.	Wt. of good ears.	Wt. of poor ears.	Wt. of stalks.
1	off	66	25	27	31	12.5	8	39
2	off	61	22	39	17	17.5	5	37.5
3	off	72	18	43	23	18	6.5	39.5
4	on	71	14	34	18	14	4	35
5	off	62	17	36	18	17.5	4.5	35
6	off	66	18	45	20	20.5	5.5	40
7	off	69	20	33	30	14.5	6.5	39
8	on	72	19	30	26	12	5	33
9	off	73	25	31	31	13	8	41
10	off	75	20	34	33	15	8	46.5
11	off	74	29	36	32	15.5	7	45.5
12	on	60	22	28	19	12.5	4	39.5
13	off	64	20	35	25	15.5	6.5	42
14	off	60	21	37	20	16.5	5	37
15	off	69	23	29	31	13	8.5	42
16	on	61	10	28	24	12.5	4.5	40
Total	off	811	258	425	311	189	79	484
"	on	264	65	120	87	51	17.5	147.5
Average.....	off	67.6	21.5	35.4	25.7	15.7	6.6	40.3
"	on	66	16.2	30	21.75	12.7	4.4	37.4

Yield per acre tassels off, 5316 lbs.

" " " " on, 4077 lbs.

Gain by removing tassels, 30.3 per cent.

From the accompanying tables it will be seen that in each plot there was a greater yield of corn from the detasseled rows than from the rows where the tassels were left on. Not only from the total yield of corn but also a gain in the weight of both the good and poor ears. From each plot the weight of good ears from detasseled rows was greater than the weight of good ears from the rows with tassels; the same is true concerning the poor ears from each plot. The average weight of the ears from rows with the tassels on, correspond very nearly with the weight of the ears from detasseled rows, showing that the increased yield is from a greater number of ears rather than larger ears. There is also shown a tendency toward greater ear production on the detasseled rows by the increased number of abortive ears. All "sets" bearing silk but without grain were classed as abortive ears.

PLOT III.

Row.	Tassels.	No. of stalks.	No. of abortive ears.	No. of good ears.	No. of poor ears.	Wt. of good ears.	Wt. of poor ears.	Wt. of stalks.
1	on	64	7	19	24	6	4	25
2	off	57	21	21	29	6	4.5	25
3	on	61	25	15	25	3	4.5	23.5
4	off	60	14	19	24	5.5	4	25
5	on	54	19	16	25	5.5	4.5	25
6	off	70	15	21	36	7	5	26
7	on	63	21	15	32	4	3.5	24
8	off	67	21	28	28	7.5	3.5	27.5
9	on	74	17	28	26	7.5	3	33
Total.....	on	316	89	93	132	28	19.5	130
"	off	254	71	89	117	26	17	103.5
Average.....	on	63.2	17.8	18.6	26.4	5.6	3.9	26
"	off	63.6	17.9	22.25	29.25	6.5	4.25	25.87

Yield per acre tassels off, 2559 lbs.

" " " " on, 2262 lbs.

Gain by removing tassels, 13 per cent.

The report of a recent experiment in detasseling is published in Bulletin 25 of the Nebraska Experiment Station where the tassels were removed by the use of a *corn knife*, and the results are summed up in the following conclusions :

1. "The detasseling of corn seems to be a positive detriment and loss, as shown by the results in two years' trial. This is not conclusive evidence, but strongly indicative of what we may expect from the practice.

2. The expense is about \$1.25 per acre and would require an increased yield from three to five bushels of corn to pay for the labor involved, this depending on the price of corn in any given locality.

3. Although the results of the experiment in 1892 are so strongly contrasted and so widely divergent, yet we do not deem them decisive. We propose to repeat the experiment on still larger areas and with different varieties of corn and note the results before we announce the positive rule that 'detasseling does not pay.'"

Although not conclusive the experiments made at this Station indicate that there is more pollen produced by the corn plant than is necessary to produce a maximum crop and that this over production is an exhaustive process.

The following are the results in brief of detasseling practiced at this Station for four years :

In 1890 a gain in total yield of corn of 50.6 per cent.

“ 1891 a very slight gain.

“ 1892 a gain in total yield of corn of 21 per cent.

“ 1893 a gain in total yield of corn of 19.3 per cent.

GEO. C. WATSON.

ENTOMOLOGICAL DEPARTMENT.

THE PEAR LEAF BLISTER.

Phytoptus pyri.

Order ACARINA ; family PHYTOPTIDAE.

Reddish blister-like spots an eighth of an inch or more in diameter appearing on pear leaves in the spring and changing to black corky spots in July, each with a minute opening in it.

In Bulletin 23 of this Station, issued in December, 1890, this disease of pear leaves was discussed at some length. It was then realized that the only methods of checking the disease which could be suggested were too laborious to be practicable except where the trees were young or few in number. This need of a cheaper and easier method of fighting this pest has been the subject for experimentation during the last two years. Some of these experiments have been strikingly successful, and we are now confident that this disease, which is alarmingly on the increase in the United States and Canada, can be easily and cheaply controlled.

As the disease has been studied during an entire season, other phases of it, not before recorded, have been seen. The disease has also appeared in several other localities and is causing considerable alarm among pear growers, judging from the reports of correspondents. It is the purpose of this article then to record these new facts, and to tell pear growers how the pest can be easily and cheaply combated. As Bulletin 23 is now out of print, it has also seemed best to again discuss the disease in detail.

Symptoms of the disease.—The disease appears on the pear leaves, before they are fully expanded from the bud in the spring, in the form of red blister-like spots an eighth of an inch or more in diameter. During this red stage of the disease, the spots are more conspicuous on the upper surface of the leaves. About June 1, the spots gradually change to a green color hardly dis-

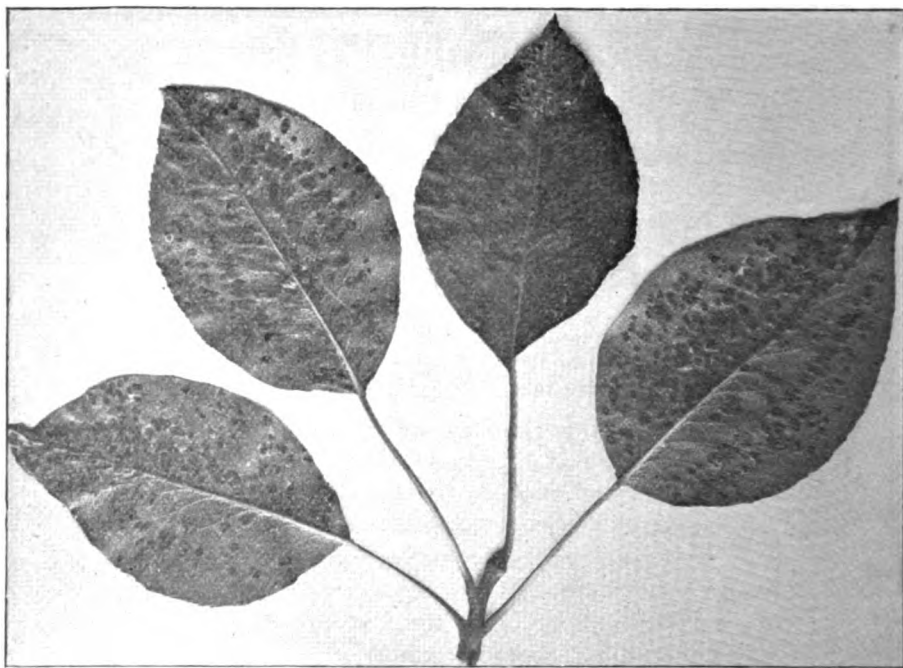


FIG. 1.—Cluster of infested leaves representing the disease in its brown stage, as seen from below on three leaves and from above on one leaf. (From a photograph of leaves collected in August. Natural size.)

tinguishable from the unaffected portions of the leaf; this change takes place on the lower side of the leaf first, and the spots may thus be red above and green below. In this green stage, which seems to have been heretofore overlooked, the badly diseased leaves present a slightly thicker corky appearance; otherwise the disease is not readily apparent especially where not severe. This green stage lasts about a week or ten days; and about June 15 the spots may be found changing to a dark brown color beginning on the lower side of the leaf. The tissue of the diseased parts or spots then present a dead, dry, brown or black, corky appearance. The spots are also more conspicuous on the lower side (Fig. 1), and remain unchanged until the leaves fall in the autumn. They occur either singly scattered over the surface of the leaves or often coalesce forming large blotches which sometimes involve

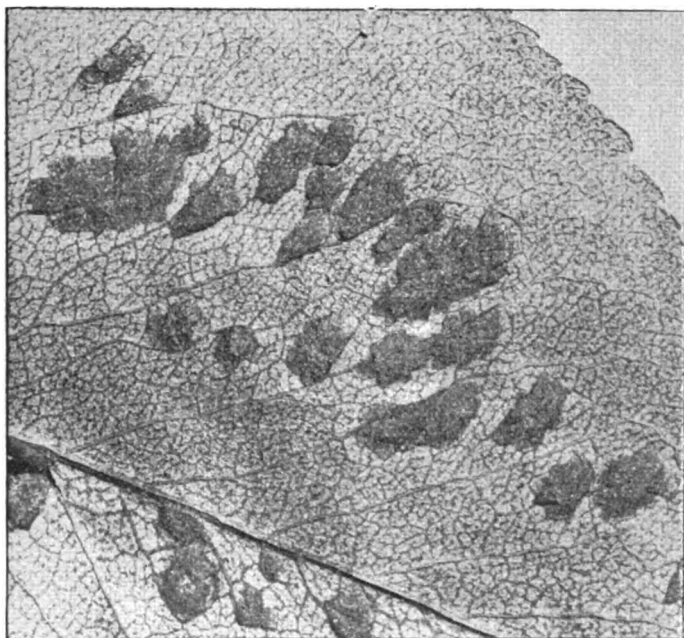


FIG. 2.—Part of an infested leaf, seen from below, showing several of the galls considerably enlarged. (From a photograph.)

a large portion of the leaf (Fig. 1). The disease often appears on the young leaves of the new growth during the summer. The spots are then also first red and pass through the green stage to the brown. No variety of pears seems to be exempt from the attacks of the disease. The disease is not known to attack anything but the pear in this country.*

This Pear Leaf Blister is sometimes mistaken for a common fungus disease, the Pear Scab, which attacks the pear, also forming blackish spots on the surface of the leaves which have a slight resemblance to the blisters. The fungus, however, does not pro-

* Mr. Crawford records the finding of similar diseased spots on a fern (a *Gleichenia*) growing among infested pear trees in Australia. Although the inhabitants of the spots differed in color from those on the pear, he believed this to be due to the difference of the food and concluded that the disease was the same on the fern and pear.

duce the blister-like corky appearance; nor is there scarcely any thickening of the leaf where it is attacked by the fungus.

These diseased portions of the leaf are termed galls, as are the various abnormal vegetable growths produced by true insects. Figure 2 represents several of these galls, or blisters as they are sometimes called by fruit growers; the galls are magnified about six diameters and well illustrate their blister-like corky appearance.

In figure 3 is shown a section of a pear leaf through one of the galls, made doubtless while the gall was in its red stage. Here the leaf is seen to be greatly thickened at the diseased part. And in addition to the swelling of both



FIG. 3.—Section of a leaf; g, gall in its red stage; n, n, normal structure of the leaf; o, opening of the gall; e, eggs. (After Sorauer.)

surfaces of the leaf, its internal structure is seen to be modified. In some parts there is a multiplication of the tissue cells, and in others a large part of the cells have been destroyed.

As the season advances and the galls become dry and brown, the thickening of the leaf becomes less marked, especially on the upper surface. Figure 4 represents a section of a leaf collected and studied in October. Here the tissues in the diseased spot are dead, and there has been a shrinkage of the affected parts until the gall is but slightly thicker than the uninjured portion of the leaf.

If these galls be examined from the lower side of the leaf with a hand lens (an instrument which every fruit grower should own) there can be seen near the center of each a minute round hole. It can be discerned in some of the galls represented in figure 2. This hole leads into a cavity within the substance of the leaf (Figs. 3 and 4, o) and in this cavity reside the creatures that cause the disease.

Appearance of the Inhabitants of the Galls.—The minute creatures that attack the tissues of the pear leaf in such a manner as to cause the abnormal growths—the galls—which form their homes, are what are popularly known as mites. They are exceedingly small, being practically invisible to the unaided eye; and even

with a good hand lens they appear as minute whitish specks. In fact, the best of microscopes is necessary in order to study their structure satisfactorily. So small are they that it would take 150 of them placed end to end, and 600 placed side by side to meas-

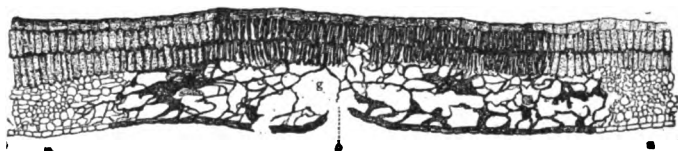


FIG. 4.--Section of leaf showing structure of gall in autumn; g, gall; n, uninjured part of leaf; o, opening of gall.

ure an inch. They are usually whitish in color, sometimes with a slight red or brown tinge. The body is cylindrical in form, tapering slightly towards each end (Fig. 5). It is ringed throughout the greater part of its length with about one hundred very fine rings. Its four legs are placed near the head end of its body, so that when the mite walks it drags its body after it. The head is in the form of a conical snout, within which are two sword-like jaws. The body and legs are furnished with a few hairs which are constant in number and position.

Classification of the Pest.—The cause of this Pear Leaf Blister is not a true insect, but a mite. (The mites are more closely allied

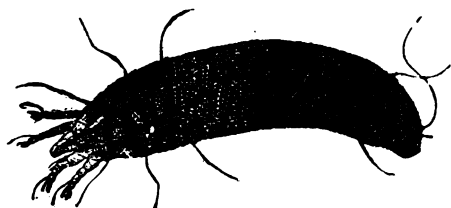


FIG. 5.—The adult mite, greatly magnified.

to the Spiders and Scorpions than to the true insects). The southern Cattle-tick, the Itch-mite, and the Red Spider are well-known members of the same order (*Acarina*)

of animals to which this pear pest belongs. As a rule, newly-hatched mites have three pairs of legs, and a fourth pair is added during growth. The members of the genus *Phytoptus*, to which this pear pest belongs, differ, however, from all other mites in that they never possess but two pairs of legs.*

* These curious four-legged mites seem to have been first observed in 1834. For 17 years they were thought to be immature forms of some eight-legged

The popular name for this pear pest that has come into general use is the Pear Leaf Blister Mite. Crawford called it the Pear Phytoptus, the Anglicized form of its scientific name *Phytoptus pyri*.

The Distribution and Past History of the Mite.—The cause of this peculiar affection of pear leaves was discovered by Scheuten, a German, in 1857; doubtless the disease itself had been observed many years previously. Later German writers, Sorauer in 1873 and 1886, Kaltenbach in 1874, and Frank in 1880 speak of the disease as common in Europe. In 1877 Murray records it as common in England and on the Continent. Crawford states that public attention was first called to the pest in South Australia in 1881. In 1891, French found it had gained a foothold in Victoria orchards. In 1888, Fletcher received specimens of the disease from Nova Scotia; and in 1891 he found it was very widespread and serious throughout Canada. These are all the references to the occurrence of the pest in other countries, that we have seen.

The first record of the appearance of the disease in the United States is in 1872 when Glover found it common in Maryland. In 1880, Burrill said the disease was widespread in this country. Osborn found the mite in large numbers on some Russian pear trees in Iowa in 1884; he thought the pest had probably been introduced with the scions of trees recently imported from Europe. In 1890, specimens were sent to Dr. Lintner from Charlotte, North Carolina with the report that the disease was very prevalent there. In 1891, we received the mites from a correspondent in Fayetteville, Ark., who said his trees were badly affected. At the meeting of the Association of Economic Entomologists in 1892, Webster of Ohio and Smith of New Jersey reported the pest as very

species. In 1851, Dujardin (An. des Sci. Nat., 3d Ser., vol. 15, p. 166) showed why he believed them to be adult forms and proposed the generic name *Phytoptus* for such four legged forms. In 1857, Scheuten, who described the Pear Leaf Blister Mite, criticized Dujardin's work and adhered to the theory that they were but immature forms. During the succeeding twenty years several observers studied the four-legged mites, and since 1877 it has been the prevailing opinion that they are adult animals forming a distinct family among the mites.

abundant in their respective States that year. This year McCarthy has found the disease very prevalent in the orchards of North Carolina.

In 1889 and 1890 the pest was abundant in pear orchards in western New York. We received specimens from Oswego in 1891; and Dr. Lintner reported it as excessively abundant in eastern New York in 1892. The disease is very common in pear orchards near Ithaca, and has very noticeably increased within the past three years. It doubtless occurs in a majority of the pear orchards in the State. This completes the recorded history of the disease in our own State and other States.

These data indicate that the disease is of European origin. It had become established in the United States in 1872 and had reached Australia in 1881, and Canada in 1888. It is widely distributed over the northern, eastern, and southern portions of the United States; and has doubtless been introduced into other sections on stock bought in the east or in Europe.

Its Destructiveness.—The destruction wrought by the mite thus far has not been very serious except in a few cases where it was excessively abundant. The infested leaves fall from the trees sooner than the others, thus depriving the tree of its breathing organs and materially weakening it. Without its leaves the tree cannot store up the necessary food in its winter buds to insure a healthy vigorous tree and a full crop the next season. The freer from disease the leaves can be kept during the summer and fall, the more vigorous will be the tree and the better will be the quality and the greater the quantity of the fruit the next season. Pear growers should therefore be on the watch for the Pear Leaf Blister and not let it get a foothold in their orchards.

The Life History of the Mite.—According to German observers, the exceedingly minute oval grayish eggs are¹ laid by the females in the spring within the galls that they have formed, and here the young are hatched. How long they remain within the gall of their parent has not been ascertained. But sooner or later they escape through the opening in it, and seeking a healthy part of a leaf or more often crawling to the tenderer leaves of the new growth, they work their way into the tissue and new galls are thus started. In this manner the galls on a tree are often rapidly

multiplied during the summer. The mites live within the galls, feeding upon the plant cells, until the drying of the leaves in the autumn. They then leave the galls through the openings and migrate to the winter buds at or near the ends of the twigs. Here they work their way beneath the two or three outer scales of the buds where they remain during the winter. Fifteen or twenty may often be found under a single bud scale. In this position they are ready for business in the spring as soon as growth begins; and they doubtless do get to work early for their red galls are already conspicuous before the leaves get unrolled.*

The mites instinctively migrate from the leaves as soon as the latter become dry. Whenever branches were brought into the insectary, as soon as the leaves began to dry, the mites left them and gathered in great numbers in the buds. It is impossible to accurately estimate the number of mites that may live in the galls on a single leaf. Sections of galls made while in their red stage would seldom cut through more than two or three mites; but sections of the brown galls often showed four or five times as many. Thus on a badly infested leaf there is without doubt at least a thousand of the mites.

Methods of Destroying the Mites.—Owing to the fact that the mites live within the tissues of the leaves during the growing season, they are then beyond the reach of ordinary insecticides. It is obvious that they would not be affected by any poison dusted or sprayed upon the surface of the leaves. In 1890 we demonstrated that the mites could not be reached by an application of kerosene emulsion to the leaves. It was hoped that a sufficient quantity of the liquid would pass into the galls through their open mouths to injuriously affect the mites, but it did not.

Thus the only practicable method of combating the pest while in the galls is to gather the infested leaves, either by picking or pruning, and burn them. This method is a sure one, and is practicable where the pest is just starting in an orchard, or where the trees are small or when but a few large trees are attacked. It

* Mr. Crawford says: "There are two ways in which the mite survives the winter when all the leaves are shed—first, by hibernating among the hairs of and in the leaf bud, and secondly by forming colonies under the tender bark of last year's growth, as I have found them in both situations."

can be done at any time before the leaves dry and fall in the autumn, but the earlier in the season the better. In May, while the galls are red, would be the best time to do it.

The most vulnerable point at which the disease can be attacked on a large scale is when the mite is in its winter quarters in the terminal winter buds. Doubtless the pest receives a considerable check in many orchards at the annual pruning to which the trees are subjected. In this manner many of the winter buds containing the mites are removed and the burning of the brush soon after destroys the pest.

The methods just discussed are sure means and are practicable within certain limits. But a method which is cheaper, easier, more practicable, and one that is effective and applicable to large orchards, has resulted from our experiments during the last two years. One winter while experimenting to learn the effects of kerosene oil on dormant wood, it was noticed that the oil penetrated every crevice of the wood with surprising thoroughness; and it was at once suspected that kerosene might be used with effectiveness against this mite while in its winter quarters under the bud scales.

In the fall of 1891, before the leaves fell, several badly infested trees were labeled; and in February, 1892, two trees were treated with undiluted kerosene, one tree with kerosene emulsion diluted with $2\frac{1}{3}$ parts of water, and one tree was left untreated as a check.

In the spring the mites appeared in force on the check tree, but upon the treated trees not more than a dozen galls appeared during the season, the pest having thus been nearly exterminated. The trees treated with the undiluted kerosene were nearly killed, so that in this form kerosene can not be used with safety on the pear. The only apparent effect upon the trees treated with the emulsion, however, was a slight retardation in the unfolding of the leaves in the spring. This experiment was of course only an indicator, but it gave the clue. The result was not given to fruit growers at the time for it needed further verification on a larger scale, and it was desirable to know what percentage of kerosene it was necessary to apply to do the work successfully.

In September, 1892, we found sixteen quite badly infested trees

in the Horticultural orchard here at the Station. These were then labeled, and March 10, 1893, all but two (which were left for a check) were sprayed with kerosene emulsion diluted with from 3 to 10 parts of water. The trees were standards varying from six to fifteen feet in height, but it was found that it required only about one and a half quarts of the diluted emulsion and about two-minutes of time to spray a tree thoroughly from all sides with a knapsack sprayer.

July 10, 1893, the trees were examined and it was found that the four sprayed with the emulsion diluted with 3 parts of water were practically free from the disease. The four trees sprayed with the emulsion diluted five times, and the four on which the emulsion diluted with eight parts of water was used showed a very few galls, not one per cent. of the number on the trees the preceding year. Two trees which had been sprayed with the emulsion diluted with 10 parts of water showed nearly as many galls as before. The two check trees were as badly infested as they were the year before.

These results showed that the emulsion was effective when diluted with not more than 8 parts of water, or containing about eight per cent. of kerosene. The remarkable success of these experiments could be fully realized only by one who had seen the diseased trees in the fall and again a year later. To illustrate it graphically one need but imagine the four leaves shown in figure 1 (which were taken in the fall and are typical specimens of the leaves on many branches of the trees before they were treated) passed through some process by which all of the galls could be removed except one or two on each leaf; this comparison does not exaggerate the difference between the trees before and after treatment with the emulsion. In all of our work with preventive methods against insect attacks, we have never met with more striking success than we obtained by the use of the emulsion against this Pear Leaf Blister Mite.*

*Mr. Crawford doubtless first suggested the use of kerosene emulsion against this pest in winter. He said: "The habits of the mite in the winter time afford a clue to one method of treating it. For this purpose I would recommend three washes to be experimented with, viz.: Kerosene emulsion,

The emulsion can be applied with equal effectiveness at any time after the leaves have fallen in autumn and before the buds have begun to swell in the spring. Dilute the emulsion† with not over 5 to 7 parts of water. Spray the tree thoroughly from every side, taking especial care to hit every terminal bud, for this is where most of the mites congregate. There is no danger of injuring the tree with this dilution of the emulsion.

In this manner the Pear Leaf Blister Mite can, we believe, be nearly exterminated in an orchard by a single thorough spraying. The method also has the great advantage of being cheap, easy to apply, and practicable on a large scale. This spraying of the tree in winter with so strong an emulsion may also destroy some of the adults of that pest most dreaded by all pear growers—the Pear Psylla—which is then in hibernation in the crevices of the bark on the trunk and large limbs; therefore spray the tree all over.

To summarize briefly, our experiments strongly indicate that

1 to 14; caustic soda, say 4, 8, and 12 ounces to the gallon; and sulphuretted lime."

He tried no experiments and our results show that so dilute an emulsion would be of little avail. Mr. Crawford's recommendation was unknown to us until after we began to write this article.

Other authors have recommended the use of the emulsion when the mites are leaving the buds or while migrating to the buds. It would be effective if the mites could be hit at this latter time, which would, however, necessitate very careful watching with a good lens to determine the exact time to make the application. They do not leave the buds in the spring, but attack the leaves while yet in the bud; and the mites are out of reach in their galls before the leaves unroll.

† To make the emulsion, thoroughly dissolve one-half pound hard or soft soap in one gallon boiling water. While this solution is still very hot add two gallons of kerosene and quickly begin to agitate the whole mass through a syringe or force-pump, drawing the liquid into the pump and forcing it back into the dish. Continue this for five minutes or until the whole mass assumes a creamy color and consistency which will adhere to the sides of the vessel, and not glide off like oil. It may now be readily diluted with cold rain water, or the whole mass may be allowed to cool when it has a semi-solid form, not unlike lopped milk. This standard emulsion if covered and placed in a cool dark place will keep for a long time. In making a dilution from this cold emulsion, it is necessary to dissolve the amount required in three or four parts of boiling water, after which cold rain water may be added in the required quantities.

the Pear Leaf Blister can be nearly exterminated in a badly infested orchard by a single thorough spraying of the trees in winter with kerosene emulsion diluted with from 5 to 7 parts of water.

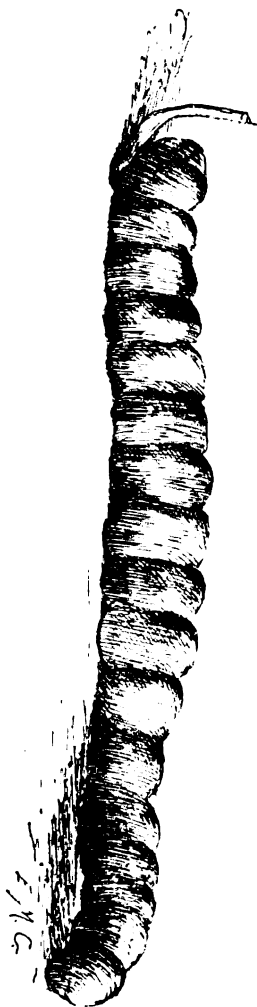
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MARK VERNON SLINGERLAND.

HORTICULTURAL DIVISION.

A NEW FOOD PLANT.—*Stachys Floridana*.*

Tuber of Stachys Floridana.

Two years ago, Dr. Erwin F. Smith, of Washington, sent us a curious tuber which he picked up on the sea coast in Florida. For two years an interesting progeny has been grown from this tuber, which proves to be *Stachys Floridana*, a plant not before introduced to cultivation, so far as I know. In general appearance, the plant is much like the Chorogi or *Stachys Sieboldii* which is sold as an esculent by the seedsman, and a detailed report of which was made from this station two years ago;† It differs from the Chorogi, amongst other things, in its more slender habit, smoothness, and its long-stalked cordate leaves. The tubers are produced as freely as in that species and are generally somewhat larger. The illustration shown herewith is a life-size picture of the greater portion of a tuber, which, however, was rather above the average size. The tubers commonly reach the length of four to six inches, and the joints are of nearly uniform thickness. The flavor is fully equal to the Chorogi, and we sometimes think it better, being perhaps, somewhat more crisp and brittle. The plant has not yet been grown in the open ground, but we now have sufficient stock to make the experiment the coming season. I expect that the plant

**Stachys Floridana*, Shuttleworth, MSS.; Ben-
tham, D. C. Prodr. xii. 478 (1848).

† Bulletin 37, p. 394.

will be able to endure our winters with the protection of a mulch, for tubers that have been frozen grow readily. There is every prospect that this interesting species will add another attractive vegetable to our gardens.

Stachys Floridana is known to occur only in eastern Florida, and it is one of the comparatively little known plants of the genus. Chapman, in his *Flora of the Southern United States*, calls it an annual, but Gray describes it as producing "a moniliform tuber of two or three inches in length."

Gray says that the plant is "barely a foot high" but under cultivation it grows to the height of two feet.



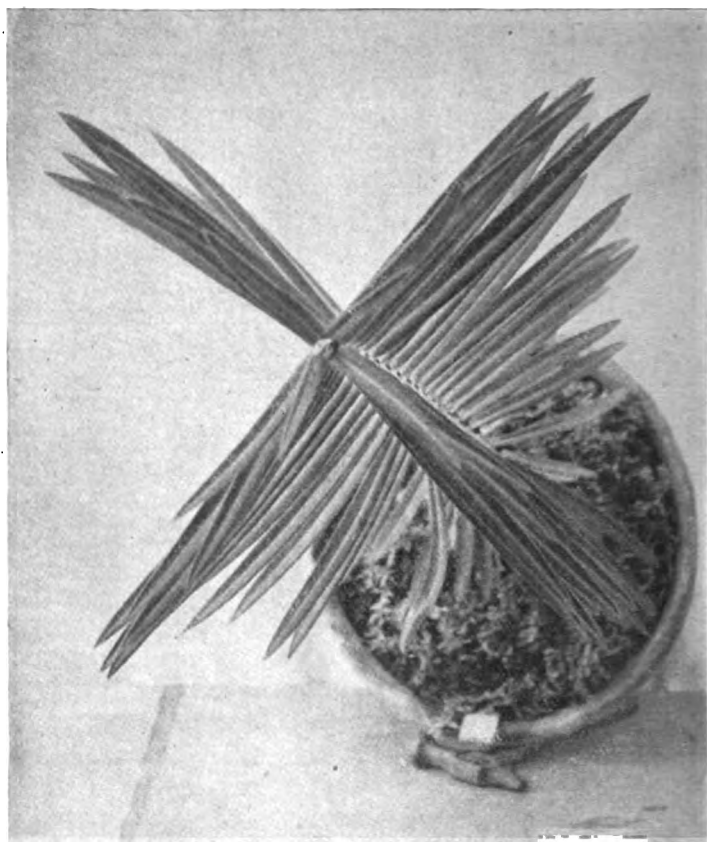
Stachys Floridana. ($\frac{3}{8}$ natural size.)

THE MOLE-PLANT.—*Euphorbia Lathyris*.*

The horticultural community was interested last spring in the announcement of Samuel Wilson, of Mechanicsville, Penn., that he had a plant which will drive moles from the garden. This plant, although said to be biennial, was called the Mole-Tree, and the account was verified by the picture, which shows a diminutive tree beneath which lies the corpse of a mole. Nothing is said by the introducer about the origin, nativity or botanical affinities of the plant. We were able to secure but one plant of the Mole-Tree, and we were so choiced of it that it has been grown in the greenhouse. It turns out to be an interesting old garden plant, which has a continuous history of at least three hundred years, and which was known as a medicinal plant to Galen in the second century. It is the Caper Spurge, *Euphorbia Lathyris*. The name Spurge is applied to many related plants, in reference to their purgative qualities, and this particular species is called Caper Spurge from the fact that the little seed-like fruits are sometimes used as a substitute for capers. The plant is known chiefly as a household medicine, although it is used in *materia medica* and is figured by Millspaugh in his recent work upon American Medicinal Plants. Its use as a food plant seems, fortunately, to have ceased. Johnson, in Sowerby's *Useful Plants of Great Britain*, 1862, speaks of this use of it as follows: "The three-celled capsules are about the size of a large caper, and are often used as a substitute for that condiment, but are extremely acrid, and not fit to eat till they have been long macerated in salt and water and afterwards in vinegar; indeed it may be doubted whether they are wholesome even in that state."

This plant is a native of Europe, but it has long been an inhabitant of old gardens in this country, and it has run wild in some of the eastern states. Its use as a mole repeller is not recent. Pursh, in writing of the plant in 1814, in his *Flora of North America*, says that "It is generally known in America by the name of Mole-plant, it being supposed that no moles disturb the ground where this plant grows." Darlington makes a sim-

* *Euphorbia Lathyris*, Linnæus, Sp. Pl. 655 (1753).



A Young Mole-plant, end view.

ilar statement in *Flora Cestrica*, 1837: "This foreigner has become naturalized about many gardens,—having been introduced under a notion that it protected them from the incursions of moles." In later botanies it is frequently called Mole-plant. I do not know if there is any foundation for these repeated statements that the Caper Spurge is objectionable to moles, but the fact that the notion is old and widespread raises a presumption that the plant may possess such attributes. This statement

occurs only in American works, so far as I know. It would be interesting to know the experiences of those who have grown the plant for a number of years, for the subject is worth investigation. But we cannot too strongly deprecate the practice of introducing plants to the public without giving purchasers definite knowledge of their history and nature, and without having detailed proof that the plants possess the virtues which are claimed for them. It would have been better in the present example, no doubt, to have submitted the plant to a botanist before introducing it, in order that its proper name and history might have been determined; and if the public is at all inclined to buy a mole-plant it would have been persuaded much more by the long tradition of its virtues than by any consequential statement of its value.

The Caper Spurge is apparently biennial, although Boissier, a celebrated monographer of the euphorbias, calls it annual. The plant is very unlike in its early and flowering stages. Until it begins to branch and flower, the leaves are long linear-lanceolate, opposite, and arranged in four perfect rows down the thick, smooth stem. As this stage of the plant is rarely illustrated or described, I have introduced here a photograph of our Mole-plant as it appeared eight months after its receipt from Mr. Wilson. It was placed horizontally and an end view was taken in order to show the serial arrangement of leaves. The plant is exceedingly curious and interesting, and we shall grow it in our greenhouses as an ornamental subject. Few plants have a more novel or striking appearance. In its second or flowering stage, the leaves are ovate and shorter. Mr. Wilson writes me that he knew this plant in old gardens more than fifty years ago, where it had a reputation for expelling moles, but he lost sight of it until a short time since, when he again met with the plant. It was then propagated and introduced to the public.

ORCHARD COVERS.

A year ago* a report was made upon the use of the European vetch (*Vicia sativa*) as a plant for growing in orchards,—to afford

*The Vetch or Tare as an Orchard Plant, Bull. 49, Cornell Exp. Sta. 354.

a cover for the soil in late summer, fall and winter, and to provide fertilizer when plowed under the following spring. Observations have been continued upon the vetch this year, and experiments have been tried with common field peas, cowpeas, and other plants, as covers for orchard lands.

The vetch is an annual leguminous plant which continues its growth long after frost and which mats down with the snow into a perfect, carpet-like covering. In the spring, the vines are so well decayed that the cover can be plowed under easily. The vetch can be sown late in June or early in July in this State, and the plants will cover the ground with a dense tangled mulch two feet deep when winter sets in. Last year (1892), we sowed the vetch June 16. This year we sowed one area June 20, and another June 28. Both made an ideal mulch, and the plants were green and still growing late in November. They produced no seeds, and but very few flowers. About a bushel of seed should be sown to the acre. The seed is large and germinates readily, and is likely to catch at almost any time during the summer. Some idea of the dense growth of the vetch this year may be obtained when I say that one patch overcame and obscured a heavy growth of horse radish which had been in the ground two years. I am confident that upon fairly good soil, good results can be obtained with vetch sown as late as the middle and possibly the last of July. We have obtained our seed from J. M. Thorburn & Co., of New York, who sell it for \$3.50 per bushel. Other dealers probably keep it. An analysis of the vetch, as given in our report for last year, and repeated below, shows that it is rich in fertilizer value.

There has been considerable inquiry concerning the value of cow peas for northern orchards. Sixteen varieties were grown at the Station this year for the purpose of ascertaining which ones will mature in this latitude; and over half an acre was sown to the Black pea, which Professor Massey, of North Carolina, thought likely to prove the best variety for our purpose. These black peas were obtained of L. R. Wyatt, Raleigh, N. C., and were sown June 20. The land was clay and variable in contour, comprising two dryish knolls, with a moist vale lying between them. The peas were slow in starting, owing to the hard soil, but they made

a fair growth in August and early September. In the vale, the plants grew nearly two feet high and covered the ground well, but on the knolls the soil was not covered. The plants had just begun to flower when they were killed by the first frost. The leaves fell off, and the bare stiff stems now afford very little protection to the soil.

The varieties of cow peas grown for the purpose of ascertaining the earliness of the various kinds, were sown May 31 in rich garden loam. These peas were obtained from the experiment stations of North Carolina, Arkansas and Louisiana. The varieties ripening seeds are ten, as follows :

- Black, from N. C.
- Black Eye, N. C.
- Blue, La.
- California Bird's Eye, Ark.
- Clay, N. C.
- Gray Prolific, N. C.
- Large White, La.
- Whipporwill, N. C., Ark., La.
- Yellow Prolific, N. C.
- Yellow Sugar Chowder, Ark.

The varieties which did not mature seeds are the following :

- Black, from La.
- Brown Eye, Ark.
- Clay, La.
- Conch, N. C.
- Indian, La.
- King, La.
- Lady, La.
- Purple Hull, La.
- Stewart, N. C.

The varieties which seemed best adapted to this latitude were the Black and Whipporwill. The latter I fruited also at Lansing, Michigan, in 1887. It will be seen that there appears to be a difference between samples of the same variety coming from different sources. The Black pea from North Carolina seed matured well, but that from Louisiana stock was too late. The same difference occurred in the Clay. This is what might have been expected,

and it emphasizes the importance of securing seed from the northernmost station, when choosing stock for growing in the north. On the whole, the Black cow pea seems best adapted to growing in Central New York. A small patch of this was sown on a rich, loose soil July 17, and the plants made as heavy growth as those sown upon the clay soil nearly a month earlier. But the cow pea affords so much less winter protection to the soil than the vetch, without any counterbalancing advantages, that it can scarcely be recommended for an orchard cover in the north.

The ordinary field pea was also grown this year as a winter cover. One lot was sown August 18. Although the tips of the plants were somewhat shriveled by frost, the plot was still green and growing the middle of November, but no flowers had appeared. The vines were two to three feet long and they covered the ground completely, and made an excellent mulch. Peas sown September 20 reached a height of about six inches and were not large enough to afford a satisfactory cover; yet, if sown very thick, peas could be put in at this time with fair result, in cases where the ground could not be used earlier.

Aside from these covers, various kinds of clovers were sown in mid-season for purposes of comparison, but they made a poor stand and afforded very little protection to the soil. Rye sown late in August or early September made a fair cover, but it is no better than common field peas, if as good, and its fertilizing value is small.

The following analyses show the fertilizer values of the various plants here discussed. The vetches and peas were analyzed at this Station. The analysis of cow peas is taken from Professor Teller's recent studies in Arkansas,* and that of clover is compiled from reliable sources for comparison.

	Original substance.	Dry substance.
<i>Vetch, ready to bloom, roots and tops.</i>		
Nitrogen.	.65 per cent.	3.10 per cent.
Phosphoric acid	.146 "	.70 "
Potash	.475 "	2.28 "
Water	.79.15	

* Bull. 24, Ark. Exp. Sta. July, 1893.

Peas, 2 to 3 ft. high, no flowers, roots and tops.

Nitrogen	.451	"	2.33	"
Phosphoric acid.....	.113	"	.58	"
Potash	.361	"	1.86	"
Water.....	80 61	"		

Peas, 6 in. high, roots and tops.

Nitrogen	.34	"	2.43	"
Phosphoric acid.....	.086	"	.62	"
Potash	.179	"	1.28	"
Water.....	86 05	"		

Cow peas (Whipporwill), in blossom, straw only.

Nitrogen	3.09	"		
Phosphoric acid..	.50	"		
Potash	1.98	"		

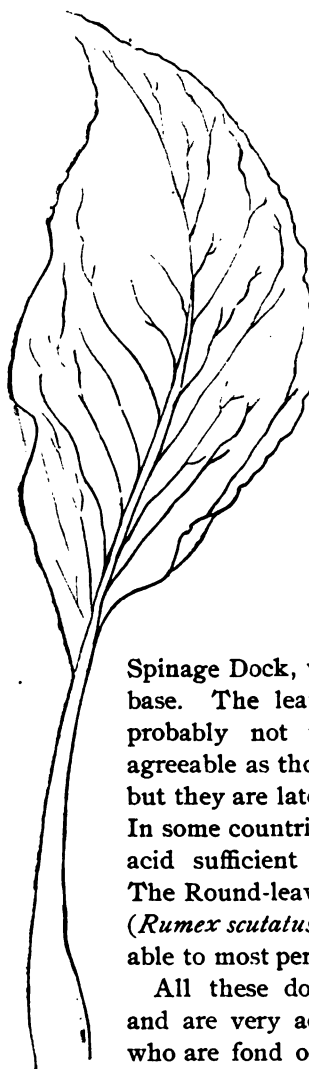
Red Clover, average of several analyses.

Nitrogen	2.05	"		
Phosphoric acid.....	.66	"		
Potash	2.24	"		

It will be seen that the vetch ranks highest in fertilizer value, although it is not greatly above cow peas. But cow peas afford little protection to the soil during winter and can therefore scarcely be recommended for an orchard cover in this latitude. Next to the vetch in value is the common field pea, and as it affords a good cover when sown as late as the middle or last of August, it may often be more useful than any other plant.

GARDEN DOCKS.

Various species of docks and sorrels have long been cultivated as pot-herbs. Some of them are very desirable additions to the garden because they yield a pleasant food very early in spring, and, once planted, they remain for years. We have grown two of the French docks for years and find them to be very good. One is the Spinage Dock (*Oseille Epinard*), the other the Large Belleville (*Oseille Large de Belleville*). The former is the better of the two, perhaps, and it has the advantage of being a week or ten days earlier. The broad crisp leaves appear early in April when there is nothing green to be had in the open garden, and they can be cut continuously for a month or more. This dock is the Herb Patience, or *Rumex Patientia* of the botanies. It has long been an inhabitant of gardens, and it has sparingly run wild in

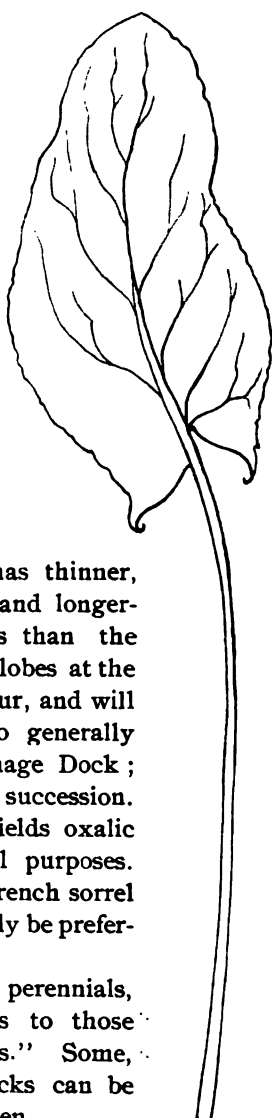


*Spinage
Dock.*

some parts of this country. It is a native of Europe. The Belleville is also a European plant, and is really a sorrel. It is *Rumex Acetosella* of botanists. It has also become spontaneous in some of the eastern portions of the country. It has thinner, lighter green and longer-stalked leaves than the

Spinage Dock, with spear-like lobes at the base. The leaves are very sour, and will probably not prove to be so generally agreeable as those of the Spinage Dock; but they are later, and afford a succession. In some countries this sorrel yields oxalic acid sufficient for commercial purposes. The Round-leaved or true French sorrel (*Rumex scutatus*) would probably be preferable to most persons.

All these docks are hardy perennials, and are very acceptable plants to those who are fond of early "greens." Some, at least, of the cultivated docks can be procured of American seedsmen.



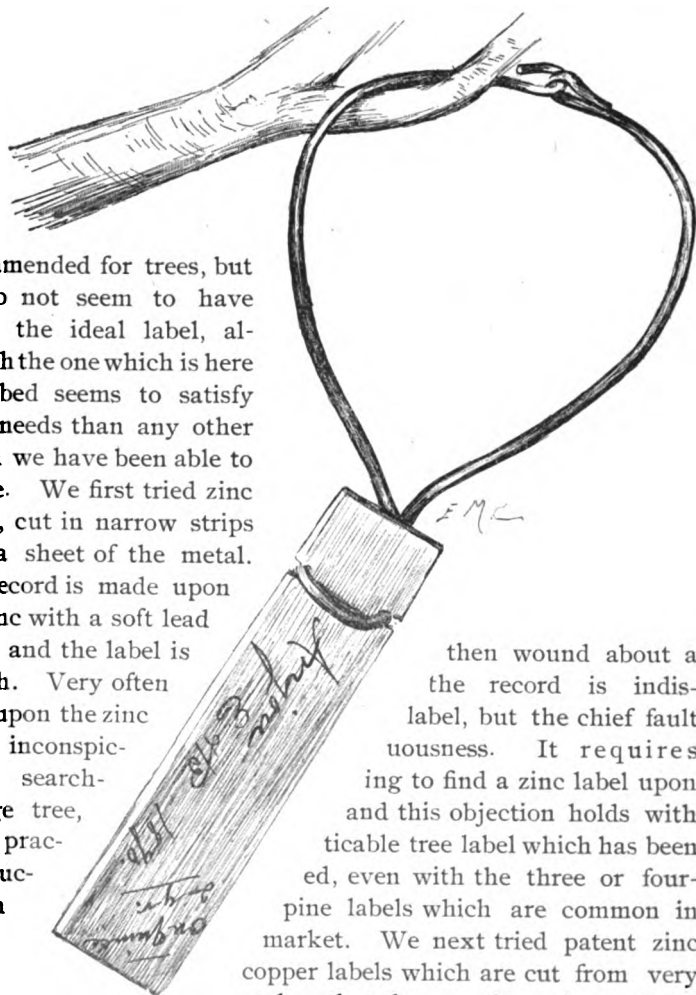
*Belleville
Dock or
Sorrel.*

LABELS.

Anyone who has had experience in gardens knows that the methods of labelling plants and trees are nearly always unsatisfactory in some particular. A great variety of labels has been

recommended for trees, but we do not seem to have found the ideal label, although the one which is here described seems to satisfy more needs than any other which we have been able to secure. We first tried zinc labels, cut in narrow strips from a sheet of the metal. The record is made upon the zinc with a soft lead pencil and the label is tinct upon the zinc branch. Very often is its inconspicuous search-a large tree, every practical introduction in the and thin

The Cornell Tree Label.



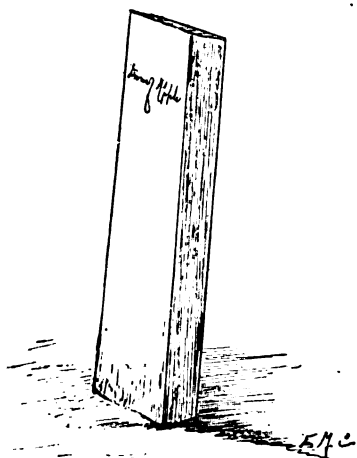
then wound about a the record is indistinct, but the chief fault is its inconspicuousness. It requires finding a zinc label upon a tree and this objection holds with every other tree label which has been introduced, even with the three or four-pine labels which are common in the market. We next tried patent zinc copper labels which are cut from very thin metal so that the record can be made by

the impression of a sharp point or style. These pretty and so-called indestructible labels are furnished with an eyelet through which the wire passes. We were much pleased with these labels when we put them upon our orchard trees one fall; but the next spring we found that the metal had broken away from the eyelets and nothing remained of them but a hole hung upon a wire.

We now label our trees with the device shown in the illustration. We buy the pine "package label" which is used by nurserymen, and which is 6 in. long and $1\frac{1}{4}$ in. wide. These labels cost, painted, \$1.30 per thousand. These are wired with stiff, heavy galvanized wire, much like that used for pail bales and not less than eighteen inches is used upon each label. Hooks are turned in the ends of the wires before the labels are taken to the field. A pail of pure white lead, well thinned with oil, is taken to the field with the labels. The record is made with a very soft pencil, the label is dipped into the paint, the wire is placed about a conspicuous limb and the hooks are joined with a pair of pliers. The paint at first almost completely obscures the writing, but some of it drips off and the remainder dries in, so that the record becomes bright and the soft pencil marks are indelibly preserved, while the label remains white. If the paint is brushed on, the soft writing will be blurred. If in the future the wood becomes gray, the label can be brightened by immersing it in a pot of white lead, without removing it from the tree. The large loop of wire allows of the growth of the branch and the label hangs so low that it can be seen at a glance. The heavy, stiff wire insures the safety of the label against boys and workmen. It cannot be removed without a pair of pincers. The label is large enough to allow of a complete record of the name of the variety, the place of purchase, age, and other matters; and it is readily found.

For temporary or annual plants, where little horse work is done, we like the commercial garden stakes, $12 \times 1\frac{1}{4}$ in. These cost us, when painted and made of soft clear pine, \$4.55 per thousand. For more permanent stake labels, we use the one shown in the picture, and which is sawed at the nearest mill. This is cut from clear pine and is 2 ft. long, $3\frac{1}{2}$ in. wide, $1\frac{1}{2}$ in. thick, and sawed to a point. These are given two thin coats of white lead, care being taken not to pile them upon their faces until thoroughly

dry, to avoid a rough surface for the pencil. The record may be made by a large soft pencil, like a carpenter's pencil, or by a brush and black paint ; but for all annual crops the pencil will be



A good Stake Label.
(24 x 3½ x 1½ in.)

found more serviceable. At the end of the season or when the record becomes dim, a thin shaving is planed off the face of the label, it is repainted, and used again. We gather up these labels from the vegetable garden each fall and dress them up during winter. The label is thick enough to allow of many annual dressings, while the lower portion is not reduced and it therefore lasts for many years and is strong enough to resist the shocks of cultivator or whippetrees. For ornamental bushes this large label is too conspicuous, and for this

purpose we use a pine label 1½ in. wide, ½ in. thick, and 18 or 20 in. long, and the lower half is soaked in a strong solution of sulphate of iron (copperas), and, after drying in lime water, to preserve it.

RECENT VARIETIES OF TOMATOES.

The year 1893 was prolific in new tomatoes. It is impossible to make an extended report upon the tomato experiments of the year at this time, but the following brief running notes of the newer varieties may be of value :

Aristocrat Dwarf (Livingston). Habit of Dwarf Champion. Fruits red, small but very even and uniform and round, solid, and attractive. Apparently a valuable amateur variety.

Baltimore Prize Taker (Landreth). A purple tomato of medium size, round and smooth. Attractive, but seemed to possess no superior merits.

Buckeye State (Livingston). A very large and productive round, heavy, purple smooth tomato. Seems to be the best novelty

of the year on our grounds, and apparently worthy of general use.

Comrade (Gregory). A small and round early tomato, red, like Prelude in shape, valuable for its earliness, although here it did not equal Advance in this respect.

Early Michigan, or *Early Red Apple* (Ferry). Red, of medium size, round and regular. A good, handsome variety, but scarcely large enough to compete with other tomatoes in the general crop. It was not very early here.

Earliest of all (Salzer). A red, angled tomato of medium size, with a tendency to be flattened. It was not early here, and it seemed to have no striking qualities.

Extra Early Advance (Burpee). Our earliest tomato this year. A small red tomato of uniform size and shape, not very far removed from the Cherry type. Valuable only on account of its earliness.

Gold Ball (Livingston). Much like the old White Apple, except a little longer and of a bright lemon color. Early.

Hubbard's Early (Jerrard). A curled-leaved variety of the old angular type, red, appearing to be identical with the old Hubbard's Curled Leaf.

La Crosse Seedling (Salzer). Mixed, part of the plants like Dwarf Champion, and others slender growers with red angular fruits. Of no value with us.

Lemon Blush (Thorburn). Fruit of medium size, bright lemon with a faint blush, early. A good variety, and apparently worth general dissemination.

Logan's Giant (Everitt). An irregular, very late tomato, of no value here.

May's Favorite (R. D. Hawley, & Co., Hartford, Conn.). A medium red tomato, uniform, regular and good. Seems promising.

Salzer's First Prize (Salzer). A flattish red variety of medium size, and apparently valuable for home use.

Salzer's Giant Tree (Salzer). Much mixed. Most of the plants bore a smallish red tomato with no pronounced attributes.

Salzer's Morning Star (Salzer). We could not distinguish it from Mikado.

Salzer's New Pot (Salzer). Mixed. Mostly like Dwarf Champion.

Semperfructifera (Pitcher and Manda). A red tomato of the

Plum type, but somewhat angular or cornered in form. It was not early with us. One plant bore a large round fruit and was evidently a "rogue." Valuable only for domestic use. *

Shenandoah (May). Large red flattish tomato of uniform size and regular. Very promising.

Storm King (Buckbee). Seems to be indistinguishable from small forms of the old White Apple.

Ten Ton (Landreth). Fruits medium to small, red, apparently not valuable here.

Terra Cotta (Thorburn). A medium to large buff-red regular tomato, of novel color. Interesting, and apparently valuable.

Topound (Huntingdon). Very much like *Shenandoah*. Good.

World's Fair (L. H. Reed, Grand Rapids, Wis.). A red flattish tomato with small foliage, and evidently an offshoot of the old angular or cornered type of tomatoes. It seems to have no particular merits here.

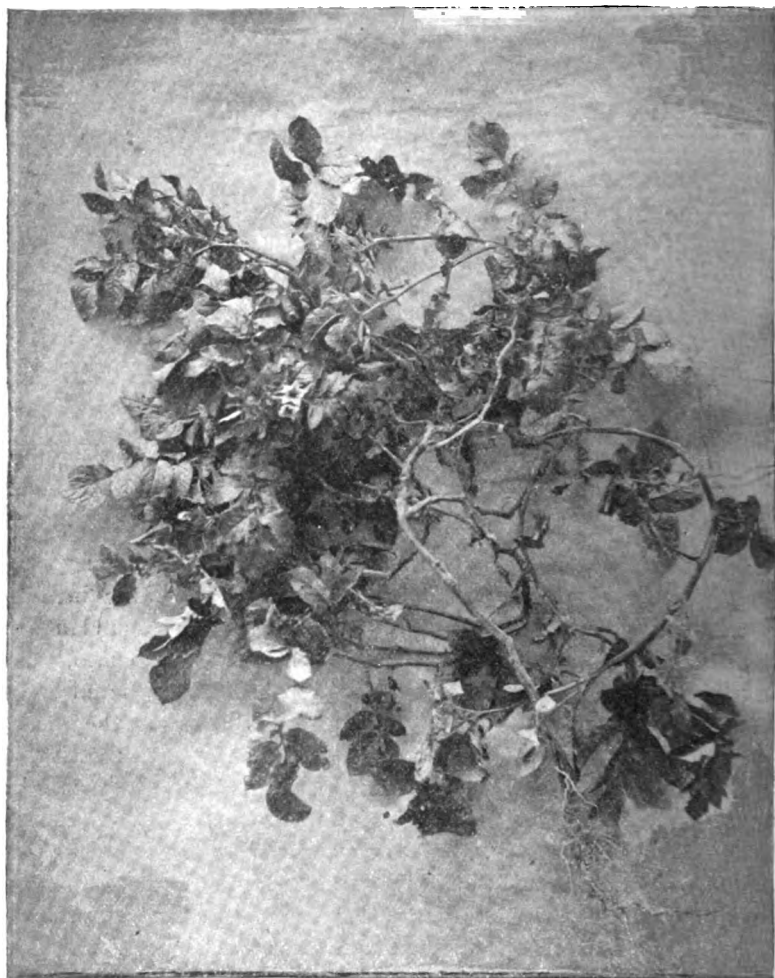
TOMATO-POTATO GRAFTS.

Frequent statements go the rounds of the press describing some mysterious or extravagant results which have been obtained by intergrafting tomatoes and potatoes; and one correspondent has reached the point of naming his mongrel the "Potomato," and from it he expects to reap compound crops of tomatoes and potatoes. The truth is that the grafting of the tomato on the potato, and *vice versa*, is no new thing; and it is equally well known that no economic results come from the union. Yet the subject is an interesting one to those who are curious concerning the habits of plants, and it is true that potato tubers will grow without potato tops and tomato fruits will ripen without tomato roots. In order to set the matter right, it has seemed best to make a report of some of these grafts which we made three years ago, although a brief account of them has already been published.*

The grafts comprised tomatoes on potatoes and potatoes on tomatoes. Plants for the purpose were grown in pots, and the grafting was done in the greenhouse when the plants were but a few inches high.†

* Carman, *The New Potato Culture*, 151.

† For an account of the methods of grafting herbs, see Bull. 25, Cornell Exp. Sta. 175.



Potato-on-tomato plant.

All sprouts were promptly removed from the stock below the union, and when the plants were set out of doors the parts were strongly knit together. Nevertheless, it was necessary to set the plants in a protected place to avoid injury from winds. The illustrations show a representative plant from each lot. It will be

seen that the tomato-on-potato plant bears a handful of tubers, together with a fair crop of tomatoes. The products of the two parts looked to be perfectly normal, although the potatoes did



Tomato-on-potato plant. Tomatoes above; potatoes below.

not grow when planted, and the tomatoes seemed to develop the full tomato flavor. In this case, there was not a potato leaf allowed to develop the entire season. The potatoes were manufactured by tomato foliage. But the plant which bore

the best crop of tomatoes bore no tubers on the potato roots—the strength seemed to have gone entirely into the tomato top.

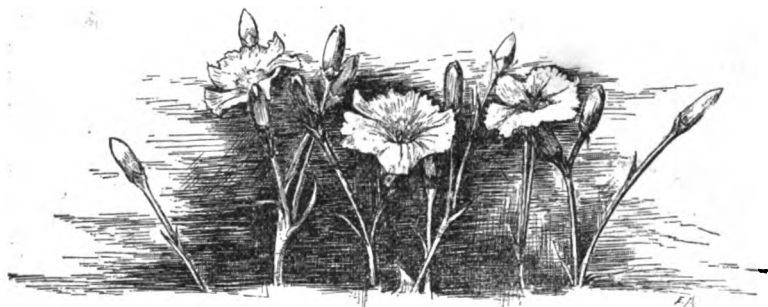
The potato-on-tomato plants were infertile ; that is, the tomato roots had no tubers and the potato tops, while they bloomed freely, produced no balls. The failure of the potato top to produce balls is probably not due to the fact that it had a tomato root, however, for comparatively few modern varieties of potatoes go to seed, even if they flower freely. There are records of potato tops on tomato roots having produced potato-like tubers in the axils of the leaves, and this curious circumstance has been thought to indicate a sort of graft-hybridism between the potato and tomato. I am ready to believe that such tubers have been produced, but they occasionally appear upon normal potato plants, and we have frequently produced them when propagating potatoes from cuttings of the growing shoots. Auxillary aerial tubers, while rare, are perfectly well known, and it would not be strange if, when the plant is prevented from making tubers in the ground, it should spend its energy elsewhere.

But however interesting these experiments may be to the plant physiologist, it is well for the reader to know that there is nothing mysterious in the operation of grafting the plants, and that there is no likelihood that any economic results will follow.

HARDY CARNATIONS.

There is comparatively little known in this country about hardy, or what the English call border carnations. The energy of American carnation growers has been directed almost entirely to the winter or house type. This winter or forcing type is a modern evolution from the hardy carnation, and there seems to be no reason why the two types should not succeed equally well in this country. Gardeners of foreign birth usually dismiss the hardy carnations by saying that our climate is too hot and dry for them. While there may be much truth in this position, it is also true that many and perhaps all of the border varieties can be grown here with little trouble. Some persons have grown them with perfect satisfaction for years, and visitors to the World's Fair in early August must have noticed a glowing bed of them upon the wooded island.

In order to determine if these plants can be successfully grown with only ordinary care, such as any person can give, we secured seeds, in the spring of 1892, of the following strains: Early Margaret, Self Colored, Early Dwarf Mixed Vienna, Red Grenadine, Splendid Rose-leaved, Picotee, and some others. These were sown in boxes in the greenhouse on the 8th of March, but they might just as well have been sown out of doors when the season opened. The plants were set in the field as the season advanced. A few of them bloomed in the fall. They were allowed to go through the winter wholly unprotected, although they grew upon bald hill-top; and the last winter was severe at Ithaca. They all wintered well, and they began to bloom about the middle of June and gave an uninterrupted display of bright colored and interesting forms until late in August. Although the lot was a

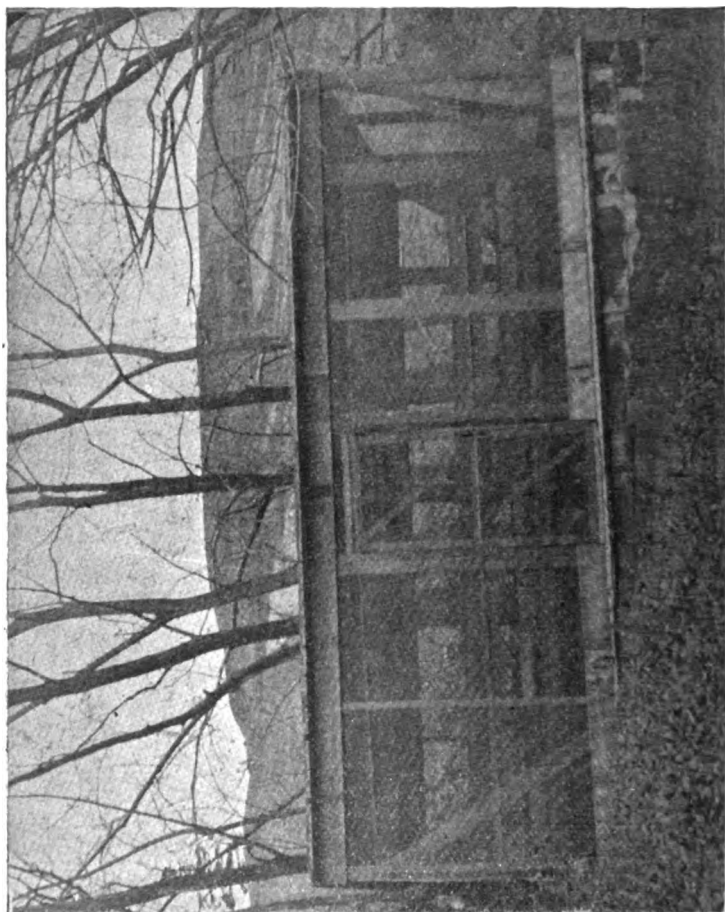


Border Carnations.—The Vienna.

mixed one, having come from seeds, all the varieties were interesting, particularly the single flowers. If any one strain were more pleasing than another, it was probably the Vienna, which bore single and semi-double little flowers of very pure and dainty colors, ranging from ivory-white to rose-red. Some of the plants had been taken up in the fall and removed to the house for winter bloom, and here, too, the Vienna was very pleasing. These hardy carnations will live on from year to year, although so good results cannot be expected from the subsequent seasons of bloom, and it is best to raise new plants from seeds.

SHED FOR STRATIFIED SEEDS.

Seeds of fruits and nuts and many hardy herbs usually germinate best when placed in moist soil and subjected to frost. It is



A Handy Seed Shed.

the practice of gardeners to place such seeds in boxes between layers of sand, and to expose them to the weather. Such seeds are said to be stratified. If more than one layer of seeds is placed

in the box it is with the intention that they shall be sifted out the next spring and sown ; but for all small parcels of seeds, such as usually fall to the lot of the experimenter, it is better to sow them regularly in boxes, and then expose them during winter, allowing them to germinate without re-sowing. Some hard seeds will not germinate under two years, and occasionally they require even more time ; but the boxes are kept clear of weeds, and the gardener abides his time.

With experimenters and others who have choice and often hybridized seeds to grow, it is a serious question what to do with these boxes of seeds, and how to keep a record of them. If kept in a building, they become too dry during winter, or if the seeds grow, the young plants are likely to die for want of light. If put out of doors, shade must be provided to keep the boxes moist and to prevent the young plants from becoming scorched by the sun ; and the boxes are likely to get upset, the labels broken off or blown out, or the rains may wash out the seeds. We have been in the habit of placing these boxes under trees, where they make a convenient sitting place for workmen, and the labels afford entertaining whittling ; and, more than all, the birds drop seeds into the boxes and destroy the value of experiments. We were much delighted with curious results which we got from boxes of hybridized raspberry and blackberry seeds ; but when one raspberry box came up to strawberries we began to think that someone or something had taken an interest in our investigations.

But we are no longer troubled. The picture shows the shed in which we keep our stratified seeds, under lock and key. We call it a Seminarium. The roof is tight, but the sides are covered only with galvanized wire netting. The meshes in this netting are never more than a half inch, so that mice are excluded. The rains and snows beat into the place, and when the seeds germinate, the plantlets find light enough for their purpose. A record-book goes with this Seminarium, with columns for the entry of the following items : Name of sample ; where from ; date of sowing ; number of box or pot ; by whom sown ; when transplanted ; permanent quarters. The house is used also for the storing of cuttings, which are planted in boxes, the same as seeds. Such quarters are indispensable to any institution where many

seeds of hardy plants are sown, and especially where experimental injury is attempted.

WHITEWASHING WITH THE SPRAYING PUMP.

The use of Bordeaux mixture in the spraying pump suggests that the machine can be used to good purpose in spraying whitewash upon greenhouse roofs, barn basements and fences. We now apply all the whitewash upon our larger glass roofs by means of a pump and nozzle. The whitewash is made in the ordinary manner, of lime and water, and is diluted to about the consistency of thin cream. If a large surface is to be covered, especially if it is difficult to reach, a direct delivery nozzle, like the Boss or a common discharge nozzle, is used, and the operator stands several feet away. But if it is desired to cover the surface evenly and neatly, the Mc Gowen nozzle is most satisfactory.

A POTATO PRESERVER.

Last spring a prominent seedsman sent us samples of potatoes, cut for planting, in very small pieces, and thickly coated with a white powder. These tubers were obtained from a dealer in potato novelties in the West, who said that he had discovered a material which would prevent the pieces of tuber from shrivelling, thus allowing the seedsman to cut away most of the flesh of the tuber and to send the lightest possible bulk through the mails. A chemical examination of the material, however, showed it to be only ordinary land-plaster (calcium sulphate). Farmers often dust plaster over freshly cut seed-potatoes for the purpose of absorbing the moisture and rendering the tubers easier to handle; and it is possible that the coating of plaster, when it dries upon the tuber, may prevent the loss of moisture and delay shrivelling, but its advantage in this respect must be small.

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